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THIRD AMERICAN EDITION.

OF

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or Dictionary of

ARTS & SCIENCES

illustrated by upwards of 180 elegant Engravings.

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AMERICAN EDITION

OF THE

BRITISH ENCYCLOPEDIA,

OR

DICTIONARY

OF

ARTS AND SCIENCES,

COMPRISING

AN ACCURATE AND POPULAR VIEW

OF THE PRESENT

IMPROVED STATE OF HUMAN KNOWLEDGE.

BY WILLIAM NICHOLSON,

Author and Proprietor of the Philosophical Journal, and various other Chemical, Philosophical, and Mathematical Works.

ILLUSTRATED WITH

UPWARDS OF 180 ELEGANT ENGRAVINGS.

VOL. VIII. MED......NIC.

PHILADELPHIA:

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Cambridge

THE

BRITISH ENCYCLOPEDIA.

MEDEOLA, in botany, a genus of the Hexandria Trigynia class and order. Natural order of Sarmentaceæ. Asparagi, Jussieu. Essential character: calyx none; corolla six-parted, revolute; berry three-seeded. There are three species, natives of the Cape of Good Hope.

MEDICAGO, in botany, *medick* or *trefoil*, a genus of the Diadelphia Decandria class and order. Natural order of Papilionaceæ or Leguminosæ. Essential character: legume compressed, bent in; keel bent down from the banner. There are eleven species. These are chiefly herbs; the leaves commonly ternate; stipules small, fastened to the bottom of the petiole; peduncles axillary and terminating, one or many-flowered, in spikes or glomerate. M. sativa, cultivated medick or lucern, is a valuable plant: it has a perennial root, with annual stalks, smooth and striated, about two feet in height; leaves ternate; leaflets elliptic, entire at the base. The common colour of the flower is a fine violet purple. For a full and clear description of this genus the reader is referred to Martyn's edition of Millar's Botany.

MEDICINE, the healing art, or science of therapeutics. In this extensive and general sense, it includes the Materia Medica, or substances employed in medicine; Pharmacy, or the mode of compounding them; and Praxis, or the phænomena of diseases and practice of medicine. In a more limited, and perhaps a more correct sense, however, the term is confined to the last division; and in this sense alone we shall understand it in the present instance, referring the reader to the article MATERIA MEDICA for the substances employed in the art of healing, and to the article PHARMACY for the mode of compounding them, and their respective results in a state of combination.

HISTORY OF MEDICINE.

The commencement of the medical profession, whether regarded as an art or a science, or both, is lost in the darkness of the earliest ages; the fabulous history of the ancients derives it immediately from their gods; and, even among the moderns, some writers of established reputation are of opinion that it may justly be considered as of divine origin; but, without adopting any supposition of which no probable evidence can be given, we may conclude that mankind were naturally led to it from casual observations on the diseases to which they found themselves subjected, and that therefore, in one sense at least, it is as ancient as the human race; but at what period it began to be practised as an art, by particular individuals following it professionally, is not known. The most ancient physicians we read of were those who embalmed the body of the patriarch Jacob by order of his son Joseph; the sacred writer styles these physicians servants to Joseph, whence we may be assured that they were not priests, as the first physicians are generally supposed to have been; for in that age we know the Egyptian priests were in such high favour, that they retained their liberty, when, through a public calamity, all the rest of the people were made slaves to the prince; it is not probable, therefore, that, among the Egyptians, religion and medicine were originally conjoined; and if we suppose the Jews not to have invented the art, but to have received it from some other nation, it is as little probable that the priests of that nation were their physicians, as those of Egypt. That the Jewish physicians were absolutely distinct from their priests is very certain. Yet, as the Jews resided for such a long time in Egypt, it is probable they would retain many of the Egyptian customs, from which it would be very difficult to free them: we read, however, that when king Asa was diseased in his feet, he sought not to the Lord, but to the physicians; hence we may conclude, that among the Jews the medicinal art was looked upon as a mere human invention; and it was thought that the deity never cured diseases by making people acquainted with the virtues of herbs, but only by his miraculous power. That the same opinion prevailed among the heathens, who were neighbours to the Jews, is also probable, from what we read of Ahaziah, king of Judah, who having sent messengers to inquire of Baalzebub, god of Ekron, concerning his disease, did not desire any remedy from him or his priests, but simply to know whether he should recover or not; what seems most probable on this subject, therefore, is, that religion and medicine intermixed themselves only in consequence of that degeneracy into ignorance and superstition, which took place among all nations.

The Egyptians, we know, came at last to be sunk in the most ridiculous and absurd superstition; and then, indeed, it is not wonderful to find their priests commencing physicians, and mingling charms, incantations, &c. with their remedies. That this was the case, though long after the days of Joseph, we are very certain, and indeed it seems as natural for ignorance and barbarism to combine religion with physic, as it is for a civilized and enlightened people to keep them separate; hence we see, that among all modern barbarians their priests or conjurers are their only physicians. We are so little acquainted with the state of physic among the Egyptians, that it is needless to say much concerning them. They attributed the invention of medicine, as they did also that of many other arts, to Thoth, the Hermes or Mercury of the Greeks; he is said to have written many things in hieroglyphic characters upon certain pillars, in order to perpetuate his knowledge, and render it useful to others. These were transcribed by Agathodemon, or the second Mercury, the father of Teut, who is said to have composed books of them; that were kept in the most sacred places of the Egyptian temples. The existence of such a person, however, is very dubious, and many of the books ascribed to him were accounted forgeries as long ago as the days of Galen; there is also great reason to suspect, that those books were written many ages after Hermes, and when physic had made considerable advances. Many of the books attributed to him are trifling and ridiculous; and though sometimes he is allowed to have all the honour of inventing the art, he is, on other occasions, obliged to share it with Osiris, Isis, and Apis, or Serapis. After all, the Egyptian physic appears to have been little else than a collection of absurd superstitions. Origen informs us, that they believed there were thirty-six demons or gods of the air, who divided the human body among them; that they had names for all of them: and that by invoking them, according to the part affected, the patient was cured.

Of natural medicine we hear of none recommended by the father of Egyptian physic, except the herb moly, which he gave to Ulysses in order to secure him from the enchantments of Circe; and the herb mercury, of which he first discovered the use. His successors employed venesection, cathartics, emetics, and clysters; there is no proof, however, that this practice was established by Hermes; on the contrary, the Egyptians themselves pretended, that the first hint of those remedies was taken from some observations on brute animals. Venesection was taught them by the hippopotamus, which is said to perform this operation upon itself; on these occasions, he comes out of the river, and strikes his leg against a sharp pointed reed; as he takes care to direct the stroke against a vein, the consequence must be a considerable effusion of blood; and this being suffered to run as long as the creature thinks proper, he at last stops up the orifice with mud. The hint of clysters was taken from the ibis, a bird which is said to give itself clysters with its bill, &c. they used venesection, however, but very little, probably on account of the warmth of the climate; and the exhibition of the remedies above mentioned, joined with abstinence, formed most of their practice.

The Greeks too had several persons to whom they attributed the invention of physic, particularly Prometheus, Apollo or Pæan, and Æsculapius; which last was the most celebrated of any; but here we must observe, that as the Greeks were a very warlike people, the physic seems to be little else than what is now called surgery, or the cure of wounds, fractures, &c.: hence Æsculapius, and his pupils Chiron, Machaon, and Podalirius, are celebrated by Homer only for their skill in curing these, without any mention of their attempting the cure of internal diseases. We are not, however, to suppose that they confined themselves entirely to surgery; they no doubt would occasionally prescribe for internal disorders, but as they were most frequently conversant with wounds, we may naturally suppose the greatest part of their skill to have consisted in knowing how to cure these. If we may believe the poets, indeed, the knowledge of medicine seems to have been very generally diffused.

Almost all the heroes of antiquity are reported to have been physicians as well as warriors. Most of them were taught physic by the Centaur Chiron; from him Hercules received instructions in the medicinal art, in which he is said to have been no less expert than in feats of arms. Several plants were called by his name; from whence some think it propable that he found out their virtues, though others are of opinion that they bore the name of this renowned hero, on account of their great efficacy in removing diseases. Aristæus, King of Arcadia, was also one of Chiron's scholars, and supposed to have discovered the use of the drug called silphium, by some thought to be assafœtida.

Theseus, Telemon, Jason, Peleus, and his son Achilles, were all renowned for their knowledge in the art of physic; the last is said to have discovered the use of verdigris in cleansing foul ulcers. All of them, however, seem to have been inferior in knowledge to Palamedes, who prevented the plague from coming into the Grecian camp, after it had ravaged most of the cities of Hellespont, and even Troy itself. His method was, to confine his soldiers to a spare diet, and oblige them to use much exercise.

The practice of these ancient Greek physicians, notwithstanding the praises bestowed upon them by their poets, seems to have been very limited, and in some cases even pernicious. All the external remedies applied to Homer's wounded heroes were fomentations; while inwardly their physicians gave them wine, sometimes mingled with cheese scraped down; a great deal of their physic also consisted in charms, incantations, amulets, &c. of which, as they are common to all superstitious and ignorant nations, it is superfluous to take any further notice. In this way the art of medicine continued among the Greeks for many ages. As its first professors knew nothing of the animal economy, and as little of the theory of diseases, it is plain, that whatever they did, must have been in consequence of mere random trials, or empiricism, in the most strict and proper sense of the word. Indeed, it is evidently impossible that this, or almost any other art could originate from any other source than trials of this kind: accordingly we find that some ancient nations were accustomed to expose their sick in temples and by the sides of highways, that they might receive the advice of every one who passed.

Among the Greeks, however, Æsculapius was reckoned the most eminent practitioner of his time, and his name continued to be revered after his death. He was ranked among the gods; and the principal knowledge of the medicinal art remained with his family to the time of Hippocrates, who reckoned himself the seventeenth in a lineal descent from Æsculapius, and who was truly the first who treated of medicine in a regular and rational manner.

Hippocrates, who is supposed to have lived four hundred years before the birth of Christ, is the most ancient author whose writings have descended to the present day: and he is hence justly regarded as the father of medicine. In his period, and indeed till a century or two ago, the distinct branches of medicine and surgery were studied and practised by the same person. Hippocrates, therefore, has been universally regarded as having contributed equally to our physiological and anatomical knowledge of the human frame, and the few anecdotes relating to him for which we can find room have been already communicated to the reader under the article ANATOMY. We shall here therefore only add those opinions of the Coan sage, which more immediately apply to the science of therapeutics, and which are more entitled to general attention.

As far as Hippocrates attempts to explain the causes of disease, he refers much to the humours of the body, particularly to the blood and the bile. He treats also of the effects of sleep, watchings, exercise, and rest, and all the benefit or mischief we may receive from them; of all the causes of diseases, however, mentioned by Hippocrates, the most general are diet and air. On the subject of diet he has composed several books, and in the choice of this he was exactly careful; and the more so, as his practice turned almost wholly upon it. He also considered the air very much; he examined what winds blew ordinarily or extraordinarily; he considered the irregularity of the seasons, the rising and setting of the stars, or the time of certain constellations; also the time of the solstices, and of the equinoxes; those days, in his opinion, producing great alterations in certain distempers; he does not, however, pretend to explain how, from these causes, that variety of diseases arises which is daily to be observed. All that can be gathered from him with regard to this is, that the different causes above mentioned, when applied to the different parts of the body, produce a great variety of disorders; some of these he accounted mortal, others dangerous, and the rest easily curable, according to the cause from whence they spring, and the parts on which they fall: in several places, also, he distinguishes diseases from the time of their duration, into acute or short, and chronical or long. He likewise distinguishes diseases by the particular places where they prevail, whether ordinary or extraordinary. The first, that is, those that are frequent and familiar to certain places, he called endemic diseases; and the latter, which ravaged extraordinarily, sometimes in one place, sometimes in another, which seized great numbers at certain times, he called epidemic, that is popular diseases; and of this kind the most terrible is the plague. He likewise mentions a third kind, the opposite of the former; and these he calls sporadic, or straggling diseases: these last include all the different sorts of distempers which invade any one season, which are sometimes of one sort, and sometimes of another. He distinguished between those diseases which are hereditary, or born with us, and those which are contracted afterwards; and likewise between those of a kindly, and such as are of a malignant nature; the former of which are easily and frequently cured, while the latter give physicians a great deal of trouble, and are seldom overcome by all their care.

A foundation for the theory and practice of medicine, being thus laid, the science was pursued with great avidity by Praxagoras, who nevertheless ventured, in some respects, to oppose the practice of Hippocrates, and by Erasistratus and Herophilus, of whom the last, as a disciple of Praxagoras, inclined rather to the Praxagorean than the Hippocratic school. Erasistratus, however, acquired a higher fame, though a more steady adherent to the older and Hippocratic doctrines, and to him we are indebted for the first regular indications of the pulse.

About this period the profession of medicine began to be divided into the three branches of dietetic, pharmaceutic, and chirurgic; or those who pretended to cure by regimen alone, disregarding, and even despising, pharmacy; those who undertook to cure chiefly by pharmaceutic preparations (of which number was Erasistratus himself); and those who devoted their whole time and attention to the chirurgical department of the medical art.

The next division of medical practitioners was into that of dogmatists and empyrics; the latter having commenced with Serapion of Alexandria, about the year 287 before Christ, who, according to Galen, retained the mode of practice of Hippocrates, but pretended to despise his mode of reasoning. In reality, this sect, to which Serapion belonged, and of which, if not the founder, he was a very zealous supporter in its earliest infancy, depended upon their own personal experience alone, whether progressive or fortuitous. On the contrary, the dogmatists affirmed that there is a necessity for knowing the latent as well as the evident causes of diseases, and that physicians ought to understand the natural actions and functions of the human body, and consequently its internal organs.

The physicians of chief fame, who flourished subsequently to this division, were Asclepiades, who opposed the Hippocratic theory of natural power and sympathy or attraction, by engrafting upon medicine the physical principles of the Epicurean philosophy: Themison, the founder of the methodic sect, whose doctrines evinced equal hostility to the dogmatists and empyrics, and divided diseases into the two classes of hypertonic and atonic, a division which in various modifications has descended to the present day; Thessalus, contemporary with Nero, a man of some merit, but of inordinate vanity; and Celsus, deservedly denominated the Latin Hippocrates, whose work is equally valuable for the purity of its language, and the knowledge it communicates of the state of medicine at the time he wrote.

About the year after Christ 131, in the reign of Adrian, appeared the celebrated Galen, whose name makes so conspicuous an appearance in the history of physic. Practitioners were at this time divided into the three sections of methodists, dogmatists, and empyrics. Galen inclined to the second party, but with a true eclectic spirit undertook to combine with its doctrine whatever existed of real worth in the two adverse systems; and hence to reform and give a finish to the science of medicine beyond what it had ever possessed before For the most part he was a follower of Hippocrates, whose name he revered, and whose opinions he commented upon; asserting in the course of his comments that he had never been thoroughly understood before. Like Hippocrates, he denominated the vital principle nature; like him he admitted the existence of four distinct humours, from the predominancy, or deficiency, or disproportion of which, originates the different temperaments of the animal frame, and the varieties in the different diseases to which it is subject: these humours are, the blood, phlegm, yellow and black bile. He likewise established three distinct kinds of auras, gases, or spirits, a natural, a vital, and an animal, which he regarded as so many instruments to distinct faculties; referring the seat and action of the first chiefly to the liver, of the second to the heart, of the third to the brain. His authority, in spite of all the fancies which are interwoven into his system, continued to prevail till the overthrow of the Roman empire, and learning and the arts were transferred to the eastern empire: under the auspices of which, however, the science of medicine does not appear to have made any progress; the Saracenic physicians, totally neglecting the study of anatomy, and every other auxiliary pursuit, and merely adding to the Materia Medica a variety of plants, whose names we now seldom hear of, and whose pharmaceutic virtues have long been despised and forgotten.

From the period at which we are now arrived, till the commencement of the sixteenth century, the history of medicine furnishes no particulars of interest. It was this epoch that gave birth to Paracelsus, who, having plunged deeply into the science of alchemy, if such a term as science be not prostituted by an application to such a subject, proscribing by one broad sweep all the reasonings of the ancient authors, endeavoured to explain all the facts and doctrines of medicine upon the principles of the fashionable science of the day.

It was in 1628, that medicine acquired a knowledge of the momentous fact of the circulation of the blood, through the indefatigable labours of Dr. W. Harvey, who nevertheless had to struggle for years against a double torrent of nearly equal violence, before the jealousies and prejudices of the profession were completely mastered: some denying the fact altogether, and others contending that it was a point that had been ascertained for ages, and consequently that he was by no means entitled to the honour of the discovery. The establishment of this important fact, however, did not, even for a long period after its general admission, produce all the advantages which might have been expected from it For the physiologists of the day, in reasoning upon the powers by which this phenomenon, as well as various others of the animal frame, was accomplished, unfortunately took hold of the mechanical philosophy as their guide; and every function was immediately attempted to be explained by the laws of projectiles, till the system at length destroyed itself by the absurdity of the extent to which it was pushed.

Boerhaave, at this period, led the way to an admirable reformation, both of principle and practice; and, by uniting the doctrines of Hippocrates with the philosophy of the times, framed a theory of medicine upon the supposition of acrimony, lentor, and other changes in the circulating fluids.

Contemporary with Boerhaave were Hoffman and Stahl; both of whom deviating from the theory of Boerhaave, the first laid the foundation of the spasmodic hypothesis, by resolving the origin of all diseases into an universal atony, or an universal spasm in the primary moving powers of the system; and the second into the action of certain noxious agents, controlled, however, by the internal existence of a rational soul that directs the entire economy. The humoral pathology, nevertheless, continued to prevail, till, under the auspices of Dr. Cullen, the theories of Hoffman and Stahl were united into one common and ingenious system; a system which still holds its ground, though it has been since controverted by the sensorial hypothesis of Dr. Brown and Dr. Darwin.

MEDICINE.

NOSOLOGY.

In order to reduce the practice of medicine to something definite, to simplify what was perplexed, and to lay down certain general rules for a more accurate investigation of diseases, physicians in all ages have attempted to arrange these last into a systematized form; and the works which have thus treated of diseases are entitled Nosologies. We cannot enter into an examination of those which have progressively been offered to the world in former periods, for this would carry us far beyond the limits prescribed by a Cyclopedia of any extent; yet while we are compelled to pass by the different arrangements of the Greeks and Romans, of the Arabians, the earlier Italians, and Germans, we cannot consent to relinquish a survey of those which are chiefly appealed to in the present day, and under which the art and science of medicine are generally taught in our public schools. We shall, for this purpose, select the five following, as affording a sufficient scope for comparison, and as offering the best arrangments of diseases which have hitherto been presented to the world: these five comprehend the nosological systems of Cullen, Sauvage, Linnæus, Vogel, and Sagar; and we shall exhibit them in their respective classes, orders, and genera.

Nosological Arrangement of CULLEN.

CLASS I. PYREXIÆ.

ORDER I. FEBRES.

§ 1. *Intermittentes.*
1. Tertiana
2. Quartana
3. Quotidiana

§ 2. *Continuæ.*
4. Synocha
5. Typhus
6. Synochus

ORDER II. PHLEGMASIÆ.

7. Phlogosis
8. Ophthalmia
9. Phrenitis
10. Cynanche
11. Pneumonia
12. Carditis
13. Peritonitis
14. Gastritis
15. Enteritis
16. Hepatitis
17. Splenitis
18. Nephritis
19. Cystitis
20. Hysteritis
21. Rheumatismus
22. Odontalgia
23. Podagra
24. Arthropuosis

ORDER III. EXANTHEMATA.

25. Variola
26. Varicella
27. Rubeola
28. Scarlatina
29. Pestis
30. Erysipelas
31. Miliaria
32. Urticaria
33. Pemphigus
34. Aphtha

ORDER IV. HÆMORRHAGIÆ.

35. Epistaxis
36. Hæmoptysis
37. Hæmorrhois
38. Menorrhagia

ORDER V. PROFLUVIA.

39. Catarrhus
40. Dysenteria

CLASS II. NEUROSES.

ORDER I. COMATA.

41. Apoplexia
42. Paralysis

ORDER II. ADYNAMIÆ.

43. Syncope
44. Dyspepsia
45. Hypochondriasis
46. Cholorsis

ORDER III. SPASMI.

47. Tetanus
48. Trismus
49. Convulsio
50. Chorea
51. Raphania
52. Epilepsia
53. Palpitatio
54. Asthma
55. Dyspnœa
56. Pertussis
57. Pyrosis
58. Cholica
59. Cholera
60. Diarrhœa
61. Diabetes
62. Hysteria
63. Hydrophobia

ORDER IV. VESANIA.

64. Amentia.
65. Melancholia.
66. Mania
67. Oneyrodynia

CLASS III. CACHEXIÆ.

ORDER I. MARCORES.

68. Tabes
69. Atrophia

ORDER II. INTUMESCENTIÆ.

§ 1. *Adiposæ.*
70. Polysarcia

§. 2. *Flatuosæ.*
71. Pneumatosis
72. Tympanites
73. Physometra

§ 3. *Aquosæ.*
74. Anasarca
75. Hydrocephalus
76. Hydrorachitis
77. Hydrothorax
78. Ascites
79. Hydrometa
80. Hydrocele

§. 4. *Solidæ.*
81. Physconia
82. Rachitis

ORDER III. IMPETIGINES.

83. Scrophula
84. Syphilis

85. Scorbutus
86. Elephantiasis
87. Lepra
88. Frambesia
89. Tricoma
90. Icterus

CLASS IV. LOCALES.

ORDER I. DYSÆSTHESIÆ.

91. Caligo
92. Amaurosis
93. Dysopia
94. Pseudoblepsis
95. Dysecœa
96. Paracusis
97. Anosmia
98. Agheustia
99. Anæsthesia

ORDER II. DYSOREXIÆ.

§1. *Appetitus erronei.*
100. Bulimia
101. Polydipsia
102. Pica
103. Satyriasis
104. Nymphomania
105. Nostalgia
§2. *Appetitus deficientes.*
106. Anorexia
107. Adipsia
108. Anaphrodisia

ORDER III. DYSCINESIÆ.

109. Aphonia
110. Mutitas
111. Paraphonia
112. Psellismus
113. Strabismus
114. Dysphagia
115. Contractura

ORDER IV. APOCENOSES.

116. Profusio
117. Ephidrosis
118. Epiphora
119. Ptyalismus
120. Enuresis
121. Gonorrhœa

ORDER V. EPISCHESES.

122. Obstipatio
123. Ischuria
124. Dysuria
125. Dyspermatismus
126. Amenorrhœa

ORDER V. TUMORES.

127. Aneurisma
128. Varix
129. Ecchymoma
130. Scirrhus
131. Cancer
132. Bubo
133. Sarcoma
134. Veruca
135. Clavus
136. Lupia
137. Gangloin
138. Hydatis
139. Hydarthrus
140. Exostosis

ORDER VII. ECTOPIÆ.

141. Hernia
142. Prolapsus
143. Luxatio

ORDER VIII. DIALYSES.

144. Vulnus
145. Ulcus
146. Herpes
147. Tinea
148. Psora
149. Fractura
150. Caries

Nosological Arrangement of SAUVAGES.

CLASS I. VITIA.

ORDER I. MACULÆ.

Genus 1. Leucoma
2. Vitiligo
3. Ephelis
4. Gutta rosea
5. Nævis
6. Ecchymoma

ORDER II. EFFLORESCENTIÆ.

7. Herpes
8. Epinictis
9. Psydracia
10. Hidroa

ORDER III. PHYMATA.

11. Erythema
12. Œdema
13. Emphysema
14. Scirrhus
15. Phlegmone
16. Bubo
17. Parotis
18. Furunculus
19. Anthrax
20. Cancer
21. Pharonychia
22. Phymosis

ORDER IV. EXCRESCENTIÆ.

23. Sarcoma
24. Condyloma
25. Verruca
26. Pterygium
27. Hordeolum
28. Bronchocele
29. Exostosis
30. Gibbositas
31. Lordosis

ORDER V. CYSTIDES.

32. Aneurisma
33. Varix
34. Hydatis
35. Marisca
36. Staphyloma
37. Lupia
38. Hydrarthus
32. Apostema
40. Exomphalus
41. Oscheocele

ORDER VI. ECTOPIÆ.

42. Exophthalmia
43. Blepharoptosis
44. Hypostophyle
45. Paraglossa
46. Proptoma
47. Exania
48. Exocyste
49. Hysteroptosis
50. Enterocele
51. Epiplocele
52. Gasterocele
53. Hepatocele
54. Splenocele
55. Hysterocele
56. Cystocele
57. Encephalocele
58. Hysteroloxia
59. Parorchydium
60. Exarthrema
61. Diartasis
62. Lexarthus

ORDER VII. PLAGÆ.

63. Vulnus
64. Punctura
65. Excoratio
66. Contusio
67. Fractura
68. Fissura

69. Ruptura
70. Amputatura
71. Ulcus
72. Exulceratio
73. Sinus
74. Fistula
75. Rhagus
76. Eschara
77. Caries
78. Arthrocace

CLASS II. FEBRES.

ORDER I. CONTINUÆ.

79. Ephemera
80. Synocha
81. Synochus
82. Typhus
83. Hectica

ORDER II. REMITTENTES.

84. Amphimerina
85. Tritæophya
86. Tetartophya

ORDER III. INTERMITTENTES.

87. Quotidiana
88. Tertiana
89. Quartana
90. Erratica

CLASS III. PHLEGMASIÆ.

ORDER I. EXANTHEMATICÆ.

91. Pestis
92. Variali
93. Pemphigus
94. Rubeola
95. Miliaris
96. Purpura
97. Erysipelas
98. Scarlatina
99. Essera
100. Aphtha

ORDER II. MEMBRANACEÆ.

101. Phrenitis
102. Paraphrenesis
103. Pleuritis
104. Gastritis
105. Enteritis
106. Epiploitis
107. Metritis
108. Cystitis

ORDER III. PARENCHYMATOSÆ.

109. Cephalitis
110. Cynanche
111. Carditis
112. Peripneumonia
113. Hepatitis
114. Splenitis
115. Nephritis

CLASS IV. SPASMI.

ORDER I. TONICI PARTIALES.

116. Strabismus
117. Trismus
118. Obstipitas
119. Contractura
120. Crampus
121. Priapismus

ORDER II. TONICI GENERALES.

122. Tetanus
123. Catochus

ORDER III. CLONICI PARTIALES.

124. Nystagmus
125. Carphologia
126. Pandiculatio
127. Apomyttosis
128. Convulsio
129. Tremor
130. Palpitatio
131. Claudicatio

ORDER IV. CLONICI GENERALES.

132. Rigor
133. Eclampsia
134. Epilepsia
135. Hysteria
136. Scelotyrbe
137. Beriberia

CLASS V. ANHELATIONES.

ORDER I. SPASMODICÆ.

138. Ephialtes
139. Sternutatio
140. Oscedo
141. Singultus
142. Tussis

ORDER II. OPPRESSIVÆ.

143. Stertor
144. Dyspnœa
145. Asthma
146. Orthopnœa
147. Angina
148. Pleurodyne
149. Rhuma
150. Hydrothorax
151. Empyema

CLASS VI. DEBILITATES.

ORDER I. DYSÆSTHESIÆ.

152. Cataracta
153. Caligo
154. Amblyopia
155. Amaurosis
156. Anosmia
157. Agheustia
158. Dysecœa
159. Paracusis
160. Cophosis
161. Anæsthesia

ORDER II. ANEPITHYMIÆ.

162. Anorexia
163. Anipsia
164. Anaphrodisia

ORDER III. DYSCINESIÆ.

165. Mutitas
166. Aphonia
167. Psellismus
168. Paraphonia
169. Paralysis
170. Hemiplegia
171. Paraplexia

ORDER IV. LEIPOPSYCHIÆ.

172. Asthenia
173. Leipothymia
174. Syncope
175. Asphyxia

ORDER V. COMATA.

176. Catalepsis
177. Ecstasis
178. Typhomania
179. Lethargus

180. Cataphora
181. Carus
182. Apoplexia

CLASS VII. DOLORES.

ORDER I. VAGI.

183. Arthritis
184. Ostocopus
185. Rhumatismus
186. Catarrhus
187. Anxietas
188. Lassitudo
189. Stupor
190. Pruritus
191. Algor
192. Ardor

ORDER II. CAPITIS.

193. Cephalalgia
194. Cephalæa
195. Hemicrania
196. Ophthalmia
197. Otalgia
198. Odontalgia

ORDER III. PECTORIS.

199. Dysphagia
200. Pyrosis
201. Cardiogmus

ORDER IV. ABDOMINALES INTERNI.

202. Cardialgia
203. Gastrodynia
204. Colica
205. Hepatalgia
206. Splenalgia
207. Nephralgia
208. Dystocia
209. Hysteralgia

ORDER V. EXTERNI ET ARTUUM.

210. Mastodynia
211. Rachialgia
212. Lumbago
213. Ischias
214. Proctalgia
215. Pudendagra

CLASS VIII. VESANIÆ.

ORDER I. HALLUCINATIONES.

216. Vertigo
217. Suffusio
218. Diplopia
219. Syrogmos
220. Hypochondriasis
221. Somnambulismus

ORDER II. MOROSITATES.

222. Pica
223. Bulimia
224. Polydipsia
225. Antipathia
226. Nostalgia
227. Panophobia
228. Satyriasis
229. Nymphomania
230. Tarantismus
231. Hydrophobia

ORDER III. DELIRIA.

232. Paraphrosyne
233. Amentia
234. Melancholia
235. Mania
236. Demonomania

ORDER IV. VESANIÆ ANOMALÆ.

237. Amnesia
238. Agrypnia

CLASS IX. FLUXUS.

ORDER I. SANGUIFLUXUS.

239. Hæmorrhagia
240. Hæmoptosis
241. Stomacace
242. Hæmatemesis
243. Hæmaturia
244. Menorrhagia
245. Abortus

ORDER II. ALVIFLUXUS.

246. Hepatirrhœa
247. Hæmorrhois
248. Dysenteria
249. Melæna
250. Nausea
251. Vomitus
252. Ileus
253. Cholera
254. Diarrhœa
255. Cœliaca
256. Lienteria
257. Tenesmus

ORDER III. SERIFLUXUS.

258. Ephidrosis
259. Epiphora
260. Coryza
261. Ptyalismus
262. Anacatharsis
263. Diabetes
264. Eneuresis
265. Dysuria
266. Pyuria
267. Leucorrhœa
268. Gonorrhœa
269. Dyspermatismus
270. Galactirrhœa
271. Octorrhœa

ORDER IV. ÆRIFLUXUS.

272. Flatulenta
273. Ædopsophia
274. Dysodia

CLASS X. CACHEXIÆ.

ORDER I. MACIES.

275. Tabes
276. Phthisis
277. Atrophia
278. Aridura

ORDER II. INTUMESCENTIÆ.

279. Polysarcia
280. Pneumatosis
281. Anasarca
282. Phlegmatia
283. Physconia
284. Graviditas

ORDER III. HYDROPES PARTIALES.

285. Hydrocephalus
286. Physocephalus
287. Hydrorachitis
288. Ascites
289. Hydrometra
290. Physometra
291. Tympanites
292. Metrorismus
293. Ischuria

ORDER IV. TUBERA.

294. Rachitis
295. Scrophula
296. Carcinoma
297. Leontiasis
298. Malis
299. Frambœsia

ORDER V. IMPETIGINES.

300. Syphilis
301. Scorbutus
302. Elephantiasis
303. Lepra
304. Scabies
305. Tinea

ORDER VI. ICTERITIÆ.

306. Aurigo
307. Melasicterus
308. Phænigmus
309 Chlorosis

ORDER VII. CACHEXIÆ ANOMALÆ.

310. Phthiriasis
311. Trichoma
312. Alopecia
313. Eleosis
314. Gangræna
315. Necrosis

Nosological Arrangement of LINNÆUS.

CLASS I. EXANTHEMATICI.

ORDER I. CONTAGIOSI.

1. Morta
2. Pestis
3. Variola
4. Rubeola
5. Petechia
6. Syphilis

ORDER II. SPORADICI.

7. Miliaria
8. Uredo
9. Aphtha

ORDER III. SOLITARII.

10. Erysipelas

CLASS II. CRITICI.

ORDER I. CONTINENTES.

11. Diaria
12. Synocha
13. Synochus
14. Lenta

ORDER II. INTERMITTENTES.

15. Quotidiana
16. Tertiana
17. Quartana
18. Duplicana
19. Errana

ORDER III. EXACERBANTES.

20. Amphimerina
21. Tritæus
22. Tetartophia
23. Hemitritæa
24. Hectica

CLASS III. PHLOGISTICI.

ORDER I. MEMBRANACEI.

25. Phrenitis
26. Paraphrenesis
27. Pleuritis
28. Gastritis
29. Enteritis
30. Proctitis
31. Cystitis

ORDER II. PARENCHYMATICI.

32. Sphacelismus
33. Cynanche
34. Peripneumonia
35. Hepatitis
36. Splenitis
37. Nephritis
38. Hysteritis

ORDER III. MUSCULOSI.

39. Phlegmone

CLASS IV. DOLOROSI.

ORDER I. INTRINSECI.

40. Cephalalgia
41. Hermicrania
42. Gravedo
43. Ophthalmia
44. Otalgia
45. Odontalgia
46. Angina
47. Soda
48. Cardialgia
49. Gastrica
50. Colica
51. Hepatica
52. Splenica
53. Pleuritica
54. Pneumonica
55. Hysteralgia
56. Nephritica
57. Dysuria
58. Pudendagra
59. Proctica

ORDER II. EXTRINSECI.

60. Arthritis
61. Ostocopus
62. Rheumatismus
63. Volatica
64. Pruritus

CLASS V. MENTALES.

ORDER I. IDEALES.

65. Delirium
66. Paraphrosyne
67. Amentia
68. Mania
69. Dæmonia
70. Vesania
71. Melancholia

ORDER II. IMAGINARII.

72. Syringmos
73. Phantasma
74. Vertigo
75. Panophobia
76. Hypochondriasis
77. Somnambulismus

ORDER III. PATHETICI.

78. Citta
79. Bulimia

80. Polydipsia
81. Satyriasis
82. Erotomania
83. Nostalgia
84. Tarantismus
85. Rabies
86. Hydrophobia
87. Cacositia
88. Antipathia
89. Anxietas

CLASS VI. QUIETALES.

ORDER I. DEFECTIVI.

90. Lassitudo
91. Langour
92. Asthenia
93. Lipothymia
94. Syncope
95. Asphyxia

ORDER II. SOPOROSI.

96. Somnolentia
97. Typhomania
98. Lethargus
99. Cotaphora
100. Carus
101. Apoplexia
102. Paraplegia
103. Hemiplegia
104. Paralysis
105. Stupor

ORDER III. PRIVATIVI.

106. Morosis
107. Oblivio
108. Ambliopia
109. Cataracta
110. Amaurosis
111. Scotomia
112. Cophosis
113. Anosmia
114. Ageustia
115. Aphonia
116. Anorexia
117. Adipsia
118. Anæsthesia
119. Atecnia
120. Atonia

CLASS VII. MOTORII.

ORDER I. SPASTICI.

121. Spasmus
122. Priapismus
123. Borborygmos
124. Trismos
125. Sardiasis
126. Hysteria
127. Tetanus
128. Catochus
129. Catalepsis
130. Agrypnia

ORDER II. AGITATORII.

131. Tremor
132. Palpitatio
133. Orgasmus
134. Subsultus
135. Carpologia
136. Stridor
137. Hippos
138. Psellismus
139. Chorea
140. Beriberi

ORDER III. AGITATORII.

141. Rigor
142. Convulsio
143. Epilepsia
144. Hieranosus
145. Raphania

CLASS VIII. SUPPRESSORII.

ORDER I. SUFFOCATORII.

146. Raucedo
147. Vociferatio
148. Risus
149. Fletus
150. Suspirium
151. Oscitatio
152. Pandiculatio
153. Singultus
154. Sternutatio
155. Tussis
156. Stertor
157. Anhelatio
158. Suffocatio
159. Empyema
160. Dyspnœa
161. Asthma
162. Orthopnœa
163. Ephialtes

ORDER II. CONSTRICTORII.

164. Aglutitio
165. Flatulentia
166. Obstipatio
167. Ischuria
168. Dysmenorrhœa
169. Dyslochia
170. Aglactatio
171. Sterilitas

CLASS IX. EVACUATORII.

ORDER I. CAPITIS.

172. Otorrhœa
173. Epiphora
174. Hæmorrhagia
175. Coryza
176. Stomacace
177. Ptyalismus

ORDER II. THORACIS.

178. Screatus
179. Expectoratio
180. Hæmoptysis
181. Vomica

ORDER III. ABDOMINIS.

182. Ructus
183. Nausea
184. Vomitus
185. Hæmatemesis
186. Iliaca
187. Cholera
188. Diarrhœa
189. Lienteria
190. Cœliaca
191. Cholirica
192. Dysenteria
193. Hæmorrhois
194. Tenesmus
195. Crepitus

ORDER IV. GENITALIUM.

196. Enuresis
197. Stranguria
198. Diabetes
199. Hæmaturia
200. Glus
201. Gonorrhœa

ORDER IV. GENITALIUM.

202. Leucorrhœa
203. Menorrhagia
204. Parturitio
205. Abortus
206. Mola

ORDER V. CORPORIS EXTERNI.

207. Galactia
208. Sudor

CLASS X. DEFORMES.

ORDER I. EMACIANTES.

209. Phthisis
210. Tabes
211. Atrophia
212. Marasmus
213. Rachitis

ORDER II. TUMIDOSI.

214. Polysarcia
215. Leucophlegmatia
216. Anasarca
217. Hydrocephalus
218. Ascites
219. Hyposarca
220. Tympanites
221. Graviditas

ORDER III. DECOLORES.

222. Cachexia
223. Chlorosis
224. Scorbutus
225. Icterus
226. Plethora

CLASS XI. VITIA.

ORDER I. HUMORALIA.

227. Aridura
228. Digitium
229. Emphysema
230. Oedema
231. Sugillatio
232. Inflammatio
233. Abscessus
234. Gangrena
235. Sphacelus

ORDER II. DIALYTICA.

236. Fractura
237. Luxatura
238. Ruptura
239. Contusura
240. Profusio
241. Vulnus
242. Amputatura
243. Laceratura
244. Punctura
245. Morsura
246. Combustura
247. Excoriatura
248. Intertrigo
249. Rhagas

ORDER III. EXULCERATIONES.

250. Ulcus
251. Cacoethes
252. Noma
253. Carcinoma
254. Ozena
255. Fistula
256. Caries
257. Arthrocace
258. Cocyta
259. Paronychia
260. Pernio
261. Pressura
262. Arctura

ORDER IV. SCABIES.

263. Lepra
264. Tinea
265. Achor
266. Psora
267. Lippitudo
268. Serpigo
269. Herpes
270. Varus
271. Bacchia
272. Bubo
273. Anthrax
274. Phlyctæna
275. Pustula
276. Papula
277. Hordeolum
278. Verruca
279. Clavus
280. Myrmecium
281. Eschara

ORDER V. TUMORES PROTUBERANTES.

282. Aneurisma
283. Varix
284. Scirrhus
285. Struma
286. Atheroma
287. Anchylosus
288. Ganglion
289. Natta
290. Spinola
291. Exostosis

ORDER VI. PROCIDENTIÆ.

292. Hernia
293. Prolapsus
294. Condyloma
295. Sarcoma
296. Pterygium
297. Ectropium
298. Phymosis
299. Clitorismus

ORDER VII. DEFORMATIONES.

300. Contractura
301. Gibber
302. Lordosis
303. Distortio
304. Tortura
305. Strabismus
306. Lagophthalmia
307. Nyctalopia
308. Presbytia
309. Myopia
310. Labarium
311. Lagostoma
312. Apella
313. Atreta
314. Plica
315. Hirsuties
316. Alopecia
317. Trichiasis

ORDER VIII. MACULÆ.

318. Cicatrix
319. Nævus
320. Morphæa
321. Vibex
322. Sudamen
323. Melasma
324. Hepatizon
325. Lentigo
326. Ephelis

Nosological Arrangement of VOGEL.

CLASS I. FEBRES.

ORDER I. INTERMITTENTES.

1. Quotidiana
2. Tertiana
3. Quartana
4. Quintana
5. Sextana
6. Septena
7. Octana
8. Nonana
9. Decimana
10. Vaga
11. Menstrua
12. Tertiana duplex
13. Quartana duplex
14. Quartana triplex

ORDER II. CONTINUÆ.

§1. *Simplices.*

15. Quotidiana
16. Synochus
17. Amatoria
18. Phrenitis
19. Epiala
20. Causos
21. Elodes
22. Lethargus
23. Typhomania
24. Leipyria
25. Phricodes
26. Lyngodes
27. Assodes
28. Cholerica
29. Synchopalis

30. Hydrophobia
31. Oscitans
32. Ictericodes
33. Pestilentialis
34. Siriasis

§ 2. *Compositæ.*

¶ 1. *Exanthematica.*

35. Variolosa
36. Morbillosa
37. Miliaris
38. Petechialis
39. Scarlatina
40. Urtica
41. Bullosa
42. Varicella
43. Pemphingodes
44. Aphthosa

¶ 2. *Inflammatoria.*

45. Phrenismus
46. Chemosis
47. Ophthalmites
48. Otites
49. Angina
50. Pleuritis
51. Peripneumonia
52. Mediastina
53. Pericarditis
54. Carditis
55. Paraphrenitis
56. Gastritis
57. Enteritis
58. Hepatitis
59. Splenitis
60. Mesenteritis
61. Omentitis
62. Peritonitis
63. Myocolitis
64. Pancreatica
65. Nephritis
66. Cistitis
67. Hysteritis
68. Erysipelacea
69. Podagrica
70. Panaritia
71. Cyssotis

¶ 3. *Symptomatica.*

72. Apoplectica
73. Catarrhalis
74. Rheumatica
75. Hæmorrhoidalis
76. Lactea
77. Vulneraria
78. Suppuratoria
79. Lenta
80. Hectica

CLASS II. PROFLUVIA.

ORDER I. HÆMORRHAGIÆ.

81. Hæmorrhagia
82. Epistaxis
83. Hæmoptoe
84. Hæmoptysis
85. Stomacace
86. Odontirrhœa
87. Otorrhœa
88. Ophthalmorrhagia
89. Hæmatemesis
90. Heptirrhœa
91. Catarrhexis
92. Hæmaturia
93. Cystirrhagia
94. Stymatosis
95. Hæmatopedesis
96. Menorrhagia
97. Abortio

ORDER III. APOCENOSES.

98. Catarrhus
99. Epiphora
100. Coryza
101. Otopuosis
102. Otoplatos
103. Ptyalismus
104. Vomica
105. Diarrhœa
106. Puorrhœa
107. Dysenteria
108. Lienteria
109. Cœliaca
110. Cholera
111. Pituitaria
112. Leucorrhois
113. Eneuresis
114. Diuresis
115. Diabetes
116. Puoturia
117. Chylaria
118. Gonorrhœa
119. Leucorrhœa
120. Exoneirosis
121. Hydropedesis
122. Galactia
123. Hypercatharsis
124. Ecphyse
125. Dysodia

CLASS III. EPISCHESES.

126. Gravedo
127. Flatulentia
128. Obstipatio
129. Ischuria
130. Amenorrhœa
131. Dyslochia
132. Deuteria
133. Agalaxis

CLASS IV. DOLORES.

134. Anxietas
135. Blestrismus
136. Pruritus
137. Catapsyxis
138. Rheumatismus
139. Arthritis
140. Cephalalgia
141. Cephalæa
142. Clavus
143. Hemicrania
144. Carebaria
145. Odontalgia
146. Hæmodia
147. Odaxismus
148. Otalgia
149. Acataposis
150. Cionis
151. Himantosis
152. Cardiogmus
153. Mastodynia
154. Soda
155. Periadynia
156. Pneumatosis
157. Cardiaglia
158. Encausis
159. Nausea
160. Colica
161. Eilema
162. Ileus
163. Stranguria
164. Dysuria
165. Lithuriasis
166. Tenesmus
167. Clunesia
168. Cedma
169. Hysteralgia
170. Dysmenorrhœa
171. Dyslochia
172. Atocia
173. Priapismus
174. Psoriasis
175. Podagra
176. Osteocopus
177. Psophos
177. Volatica
179. Epiphlogisma

CLASS V. SPASMI.

180. Tetanus
181. Opisthotonus
182. Episthotonus
183. Catochus
184. Tremor
185. Frigus
186. Horror
187. Rigor
188. Epilepsia
199. Heclampsia
190. Hieranosus
191. Convulsio
192. Raphania
193. Chorea
194. Crampus
195. Scelerotyrbe
196. Angone
197. Glossocele
198. Glossocoma
199. Hippos
200. Illosis
201. Cinclesis
202. Cataclasis
203. Cillosis
204. Sternutatio
205. Tussis
206. Clamor
207. Trismus
208. Capistrum
209. Sardiasis
210. Gelasmus
211. Incubus
212. Singultus
213. Palpitatio
214. Vomitus
215. Ructus
216. Ruminatio
217. Oesophagismus
218. Hypochondriasis
219. Hysteria
220. Phlogosis
221. Digitium

CLASS VI. ADYNAMIÆ.

222. Lassitudo
223. Asthenia
224. Torpor
225. Adynamia
226. Paralysis
227. Paraplegia
228. Hemiplegia
229. Apoplexia
230. Catalepsis
231. Carus

MEDICINE.

232. Coma
233. Somnolentia
234. Hypophasis
235. Ptosis
236. Amblyopia
237. Mydriasis
238. Amaurosis
239. Cataracta
240. Synizezis
241. Glaucoma
242. Achlys
243. Nyctalopia
244. Hermeralopia
245. Hemalopia
246. Dysicoia
247. Surditas
248. Anosmia
249. Apogeusis
250. Asaphia
251. Clangor
252. Raucitas
253. Aphonia
254. Leptophonia
255. Oxyphonia
256. Rhenophonia
257. Mutitas
258. Traulotis
259. Psellotis
260. Ischnophonia
261. Battarismus
262. Suspirium
263. Oscitatio
264. Pandiculatio
265. Apnæa
266. Macropnœa
267. Dyspnœa
268. Asthma
269. Orthopnœa
270. Pnigma
271. Renchus
272. Rhochmos
273. Lipothymia
274. Syncope
275. Asphyxia
276. Apepsia
277. Dyspepsia
278. Diaphthora
279. Anorexia
280. Anatrope
281. Adypsia
282. Acyisis
283. Agenesia
284. Anodynia

CLASS VII. HYPÆRESTHESES.

285. Antipathia
286. Agrypnia
287. Phantasma
288. Caligo
289. Hæmalopia
290. Marmaryge
291. Dysopia
292. Susurrus
293. Vertigo
294. Apogeusia
295. Polydipsia
296. Bulimus
297. Addephagia
298. Cynorexia
299. Allotriophagia
300. Malacia
301. Pica
302. Bombus
303. Celsa

CLASS VIII. CACHEXIÆ.

304. Cachexia
305. Chlorosis
306. Icterus
307. Malanchlorus
308. Atrophia
309. Tabes
310. Phthisis
311. Hydrothorax
312. Rachitis
313. Anasarca
314. Ascites
315. Hydrocystis
316. Tympanites
317. Hysterophyse
318. Scorbutus
319. Syphilis
320. Lepra
321. Elephantiasis
322. Elephantia
323. Plica
324. Phthiriasis
325. Physconia
326. Paracyisis
327. Gangræna
328. Sphacelus

CLASS IX. PARANOIÆ.

329. Athymia
330. Delirium
331. Mania
332. Melancholia
333. Ecstasis
334. Ecplexis
335. Enthusiasmus
336. Stupiditas
337. Amentia
338. Oblivio
339. Somnium
340. Hypnobatasis

CLASS X. VITIA.

ORDER I. INFLAMMATIONES.

341. Ophthalmia
342. Blepharotis
343. Erysipelas
344. Hieropyr
345. Paronychia
346. Onychia
347. Encausis
348. Phymosis
349. Paraphimosis
350. Pernio

ORDER II. TUMORES.

351. Plegmone
352. Furunculus
353. Anthrax
354. Abscessus
355. Onyx
356. Hippopyon
357. Phygethlon
358. Empyema
359. Phyma
360. Ecthymata
361. Urticaria
362. Parulus
363. Epulus
364. Anchylops
365. Paraglossa
366. Chilon
367. Scrophula
368. Bubon
369. Bronchocele
370. Parotis
371. Gongrona
372. Sparganosis
373. Coilima
374. Scirrhus
375. Cancer
376. Scarcoma
377. Polypus
378. Condyloma
379. Ganglion
380. Ranula
381. Terminthus
382. Oedema
383. Encephalocele
384. Hydrocephalum
385. Hydrophthalmia
386. Spina bifida
387. Hydromphalus
388. Hydrocele
389. Hydrops Scroti
390. Steatites
391. Pneumatosis
392. Emphysema
393. Hysteroptosis
394. Cystoptosis
395. Archoptoma
396. Bubonocele
397. Oscheocele
398. Omphalocele
399. Merocele
400. Enterocele ovularis
401. Ischiatocele
402. Elytrocele
403. Hypogastrocele
404. Cystocele
405. Cyrtoma
406. Hydrenterocele
407. Varix
408. Aneurisma
409. Cirsocele
410. Gastrocele
411. Hepatocele
412. Splenocele
413. Hysterocele
414. Hygrocirsocele
415. Sarcocele
416. Physocele
417. Exostoses
418. Hyperostosis
419. Pædarthrocace
420. Encystis
421. Staphyloma
422. Staphylosis
423. Fungus
424. Tofus
425. Flemen

ORDER III. EXTUBERANTIÆ.

426. Verruca
427. Porrus
428. Clavus
429. Callus

430. Encanthis
431. Pladarotis
432. Pinnula
433. Pterygium
434. Hordeolum
435. Grando
436. Varus
437. Gutta rosacea
438. Ephelis
439. Esoche
440. Exoche

ORDER IV. PUSTULÆ AND PAPULÆ.

441. Epinyctis
442. Phlyctæna
443. Herpes
444. Scabies
445. Aquula
446. Hydroa
447. Variola
448. Varicella
449. Purpura
450. Encauma

ORDER V. MACULÆ.

451 Ecchymoma
452. Petechiæ
453. Morbilli
454. Scarlatæ
455. Lentigo
456. Urticaria
457. Stigma
458. Vibex
459. Vitiligo
460. Leuce
461. Cyasma
462. Lichen
463. Selina
464. Nebula

ORDER VI. DISSOLUTIONES.

465. Vulnus
466. Ruptura
467. Rhagas
468. Fractua
469. Fissura
470. Plicatio
471. Thlasis
472. Luxatio
473. Subluxatio
474. Diachalasis
475. Attritis
476. Porrigo
477. Aposyrma
478. Anapleusis
479. Spasma
480. Contusio
481. Diabrosis
482. Agomphiasis
483. Eschara
484. Piptonychia
485. Cacoethes
486. Therioma
487. Carcinoma
488. Phagedæna
489. Noma
490. Sycosis
491. Fistula
492. Sinus
493. Caries
494. Achores
495. Crusta lactea
496. Favus
497. Tinea
498. Argemon
499. Ægilops
500. Ozæna
501. Aphthæ
502. Intertrigo
503. Rhacosis

ORDER VII. CONCRETIONES.

504. Ancyloblepharon
505. Zynizesis
506. Dacrymoma
507. Ancyloglossum
508. Ancylosis
509. Cicatrix
510. Dactylion

CLASS XI. DEFORMITATES.

511. Phoxos
512. Gibber
513. Caput obstipum
514. Strabismus
515. Miopyasis
516. Lagophthalmus
517. Trichiasis
518. Ectropium
519. Entropium
520. Rhœas
521. Rhyssemata
522. Lagocheilos
523. Melachosteon
524. Hirsuties
525. Canities
526. Distrix
527. Xirasia
528. Phalacrotis
529. Alopecia
530. Madarosis
531. Ptilosis
532. Rodatio
533. Phalangosis
534. Coloboma
535. Cercosis
536. Cholosis
537. Gryposis
538. Nævus
539. Monstrositas
540. Polysarcia
541. Ischnotis
542. Rhicnosis
543. Varus
544. Valgus
545. Leiopodes
546. Apella
547. Hypospadiæos
548. Urorhœas
549. Atreta
550. Saniodes
551. Cripsorchis
552. Hermaphrodites
553. Dionyfiscus
554. Artetiscus
555. Nefrendis
556. Spanopogon
557. Hyperartetiscus
558. Galiancon
559. Galbulus
560. Mola

Nosological Arrangement of SAGAR.

CLASS I. VITIA.

ORDER. I. MACULÆ.

1. Leucoma
2. Vitiligo
3. Ephelis
4. Nævus
5. Ecchymoma

ORDER II. EFFLORESCENTIA.

6. Pustula
7. Papula
8. Phlycthæna
9. Bacchia
10. Varus
11. Herpes
12. Epinyctis
13. Hemeropathos
14. Psydracia
15. Hydroa

ORDER III. PHYMATA.

16. Erythema
17. Oedema
18. Emphysema
19. Scirrhus
20. Inflammatio
21. Bubo
22. Parotis
23. Faruncullus
24. Anthrax
25. Cancer
26. Paronychia
27. Phymosis
28. Sarcoma
29. Condyloma
30. Verruca
31. Pterygium
32. Hordeolum
33. Trachelophyma
34. Exostosis

ORDER V. CYSTIDES.

35. Aneurysma
36. Varix
37. Marisca
38. Hydatis
39. Staphyloma
40. Lupia
41. Hydarthrus
42. Apostema
43. Exomphalus
44. Oscheophyma

ORDER VI. ECTOPIÆ.

45. Exophthalmia
46. Blepharoptosis
47. Hypostaphyle
48. Paraglossa
49. Proptoma
50. Exania
51. Exocystis
52. Hysteroptosis
53. Colpoptosis
54. Gastrocele
55. Omphalocele
56. Hepatocele
57. Merocele
58. Bubonocele
59. Opodeocele
60. Ischiocele
61. Colpocele
62. Pirinæocele
63. Peritonæorixis
64. Encephalocele
65. Hysteroloxia
66. Parorchydium
67. Exarthrema
68. Diastasis
69. Loxarthrus
70. Gibbositas
71. Lordosis

ORDER VII. DEFORMITATES.

72. Lagostoma
73. Apella
74. Polymerisma
75. Epidosis
76. Anchylomerisma
77. Hirsuties

CLASS II. PLAGÆ.

ORDER I. SOLUTIONES.

Recentes, Cruentæ.

78. Vulnus
79. Punctura
80. Sclopetoplaga
81. Morsus
82. Excoriatio
83. Contusio
84. Ruptura

ORDER II. SOLUTIONES.

Recentes, Cruentæ, Artificiales.

85. Operatio
86. Amputatio
87. Suturu
88. Paracentesis

ORDER III. SOLUTIONES.

Incruentæ.

89. Ulcus
90. Exulceratio
91. Fistula
92. Sinus
93. Eschara
94. Caries
95. Arthrocace

ORDER IV. SOLUTIONES.

Anomalæ.

96. Rhagas
97. Ambustio
98. Fractura
99. Fissura

CLASS III. CACHEXIÆ.

ORDER I. MACIES.

100. Tabes
101. Phthisis
102. Atrophia
103. Hæmatoporia
104. Aridura

ORDER II. INTUMESCENTIÆ.

105. Plethora
106. Polysarcia
107. Pneumatosis
108. Anasarca
109. Phlegmatia
110. Physconia
111. Graviditas

ORDER III. HYDROPES.

Partiales.

112. Hydrocephalus
113. Physocephalus
114. Hydrorachitis
115. Ascites
116. Hydrometra
117. Physometra
118. Tympanites
119. Meteorismus

ORDER IV. TUBERA.

120. Rachitis
121. Scrophula
122. Carcinoma
123. Leontiasis
124. Malis
125. Frambœsia

ORDER V. IMPETIGINES.

126. Syphilis
127. Scorbutus
128. Elephantiasis
129. Lepra
130. Scabies
131. Tinea

ORDER VI. ICTERITIÆ.

132. Aurigo
133. Melanicterus
134. Phœnigmus
135. Chlorosis

ORDER VII. ANOMALÆ.

136. Phthiriasis
137. Trichoma
138. Alopecia
139. Elcosis
140. Gangræna
141. Necrosis

CLASS IV. DOLORES.

ORDER I. VAGI.

142. Arthritis
143. Ostocopus
144. Rheumatismus
145. Catarrhus
146. Anxietas
147. Lassitudo
148. Stupor
149. Pruritus
150. Algor
151. Ardor

ORDER II. CAPITIS.

152. Cephalalgia
153. Cephalæa
154. Hemicrania
155. Ophthalmia
156. Otalgia
157. Odontalgia

ORDER III. PECTORIS.

158. Pyrosis
159. Cardiogmus

ORDER IV. ABDOMINIS.

160. Cardialgia
161. Gastrodynia
162. Colica
163. Hepatalgia
164. Splenalgia
165. Nephralgia
166. Hysteralgia

ORDER V. EXTERNARUM.

167. Mastodynia
168. Rachialgia
169. Lumbago
170. Ischias
171. Proctalgia
172. Pudendagra
173. Digitium

CLASS V. FLUXUS.

ORDER I. SANGUIFLUXUS.

174 Hæmorrhagia
175. Hæmoptysis
176. Stomacace
177. Hæmatemesis
178. Hæmaturia
179. Metrorrhagia
180. Abortus

ORDER II. ALVIFLUXUS.

Sanguinolenti.

181. Hepatirrhœa
182. Hæmorrhois
183. Dysenteria
184. Melæna

ORDER III. ALVIFLUXUS.

Non Sanguinolenti.

185. Nausea
186. Vomitus
187. Ileus
188. Cholera
189. Diarrhœa
190. Cœliaca
191. Lienteria
192. Tenesmus
193. Proctorrhœa

ORDER IV. SERIFLUXUS.

194. Ephidrosis
195. Epiphora
196. Coryza
197. Ptyalismus
198. Anacatharis
199. Diabetes
200. Enuresis
201. Pyuria
202. Leucorrhœa
203. Lochiorrhœa
204. Gonorrhœa
205. Galactirrhœa
206. Otorrhœa

ORDER V. ÆRIFLUXUS.

207. Flatulentia
208. Ædopsophia
209. Dysodia

CLASS VI. SUPPRESSIONES.

ORDER I. EGERENDORUM.

210. Adiapneustia
211. Sterilitas
212. Ischuria
213. Dysuria
214. Aglactatio
215. Dyslochia

ORDER II. INGERENDORUM.

216. Dysphagia
217. Angina

ORDER III. IMI VENTRIS.

218. Dysmenorrhœa
219. Dystocia
220. Dyshæmorrhois
221. Obstipatio

CLASS VII. SPASMI.

ORDER I. TONICI PARTIALES.

222. Strabismus
223. Tris
224. Obstipitas
225. Contractura
226. Crampus
227. Priapismus

ORDER II. TONICI GENERALES.

228. Tetanus
229. Catochus

ORDER III. CLONICI PARTIALES.

230. Nystagmus
231. Carphologia
232. Subsultus
233. Pandiculatio
234. Apomystosis
235. Convulsio
236. Tremor
237. Palpitatio
238. Claudicatio

ORDER IV. CLONICI GENERALES.

239. Phricasmus
240. Eclampsia
241. Epilepsia
242. Hysteria
243. Scelotyrbe
244. Beriberia

CLASS VIII. ANHELATIONES.

ORDER I. SPASMODICÆ.

245. Ephialtes
246. Sternutatio
247. Oscedo
248. Singultus
249. Tussis

ORDER II. SUPPRESSIVÆ.

250. Stertor
251. Dyspnœa
252. Asthma
253. Orthopnœa
254. Pleurodyne
255. Rheuma
256. Hydrothorax
257. Empyema

CLASS IX. DEBILITATES.

ORDER I. DYSÆSTHESIÆ.

258. Amblyopia
259. Caligo
260. Cataracta
261. Amaurosis
262. Anosmia
263. Agheustia
264. Dysecœa
265. Paracusis
266. Cophosis
267. Anæsthesia

ORDER II. ANEPITHYMIÆ.

268. Anorexia
269. Adipsia
270. Anaphrodisia

ORDER III. DYSCINESIÆ.

271. Mutitas
272. Aphonia
273. Psellismus
274. Cacophonia
275. Paralysis
276. Hemiphlegia
277. Paraplexia

ORDER IV. LEIPOPSYCHIÆ.

278. Asthenia
279. Lypothymia
280. Syncope
281. Asphyxia

ORDER V. COMATA.

282. Catalepsis
283. Ecstasis
284. Typhomania
285. Lethargus
286. Cataphora
287. Carus
288. Apoplexia

CLASS X. EXANTHEMATA.

ORDER I. CONTAGIOSA.

289. Pestis
290. Variola
291. Pemphigus
292. Purpura
293. Rubeola
294. Scarlatina

ORDER II. NON CONTAGIOSA.

295. Miliaris
296. Erysipelas
297. Essera
298. Aphtha

CLASS XI. PHLEGMASIÆ.

ORDER I. MUSCULOSÆ.

299. Phlegmone
300. Cynanche
301. Myositis
302. Carditis

ORDER II. MEMBRANACEÆ.

303. Phrenitis
304. Diaphragmitis
305. Pleuritis
306. Gastritis
307. Enteritis
308. Epiploitis
309. Cystitis

ORDER III. PARENCHYMATOSÆ.

310. Cephalitis
311. Peripneumonia
312. Hepatitis
313. Splenitis
314. Nephritis
315. Metritis

CLASS XII. FEBRES.

ORDER I. CONTINUÆ.

316. Judicatoria
317. Humoraria
318. Frigeraria
319. Typhus
320. Hectica

ORDER II. REMITTENTES.

321. Amphimerina
322. Tritæophya
323. Tetartophya

ORDER III. INTERMITTENTES.

324. Quotidiana
325. Tertiana
326. Quartana
327. Erratica

CLASS XIII. VESANIÆ.

ORDER I. HALLUCINATIONES.

328. Vertigo
329. Suffusio
330. Diplopia
331. Syrigmos
332. Hypochondriasis
333. Somnambulismus

ORDER II. MOROSITATES.

334. Pica
335. Bulimia
336. Polydipsia
337. Antipathia
338. Nostalgia
339. Panophobia
340. Satyriasis
341. Nymphomania
342. Tarantismus
343. Hydrophobia
344. Rabies

ORDER III. DELIRIA.

345. Paraphrozine
346. Amentia
347. Melancholia
348. Dæmonomania
349. Mania

ORDER IV. ANOMALÆ.

350. Amnesia
351. Agrypna

Our remarks upon these different arrangements must be cursory. That of Vogel would appear at first sight to be the fullest, as comprising not less than five hundred and sixty distinct genera of diseases; and that of Cullen the least complete, as extending to not more than a hundred and fifty; but when it is reflected upon, that nearly five parts out of six of the distinct genera of Vogel are regarded as mere species of other genera by Cullen, and arranged accordingly; the latter must at once be allowed to be equally full, and to possess a high advantage in point of simplicity. Sagar's is the most numerous next to Vogel's; and, like Vogel's, it is numerous, not from the possession of additional matter, but from extending to distinct genera diseases of the same genus, and which ought to rank merely as separate species, or even varieties. In the general arrangement of these nosologists, we perceive a considerable resemblance to that of Sauvage: their classes, though differently disposed, are nearly alike, as well in name as in number; yet Sauvage's is the most simple, at the same time that it is the most comprehensive. The arrangement of Linnæus is, like all his arrangements, neat and classical, perhaps the most classical of the whole of those now before us. His system is in a great measure his own: he has however more classes and genera, but fewer orders, than Sauvage; and it is not always that the terms of his classes are sufficiently characteristic of the diseases that rank under them. Many of those that are disposed under the class quietales, for example, are as much diseases of the mind, as several that are placed immediately under the class mentales; and we are afraid that the term dolorosi, peculiarly applied to Class IV. is just as applicable to a great multitude of diseases distributed under other classes, as it is to the tribe which is thus connectively arranged.

Of Dr. Cullen's table it is obvious that its chief features are due to him alone—his classes are for the most part simple, and at the same time comprehensive, his orders are natural, and his genera ably disposed. The most objectionable of his classes is the last, or that entitled locales, which, like the cryptogamia of Linnæus's botanical system, is a mere appendix, for the purpose of comprehending whatever could not be conveniently disposed under the previous heads. There is also some confusion as to a few of his orders, and we may here enumerate profluvia in Class I. compared with apocenoses in Class IV. since the former is only a Latin, and the latter a Greek word of the same meaning; and since the diseases in the former order are only distinct genera of the latter in many instances; there is also some doubt as to the situation of several of his genera. Nevertheless, it is, upon the whole, the best division that has hitherto appeared; it is far more generally studied and lectured from than any other; and under this division therefore we shall proceed to notice, cursorily, the different genera, according to this classification, and to describe the character and mode of cure of the more common or more prominent.

PRAXIS.

This is the last division comprised under this article; and, from the explanation we have just given of it, it is obvious that it is the most important.

CLASS I.

PYREXIÆ.

Frequent pulse, succeeded by shivering or horror; increased heat; disturbed functions; prostration of strength.

ORDER I. *Febris*. FEVER.

Pyrexy independent of local affection as its cause; langour, lassitude, and other signs of debility.

This order is divided into two sections, an intermittent, including tertians, quartans, and quotidians, with the different varieties of these distinct genera; and continued, which include the genera of synocha, or simple inflammatory fever; typhus, putrid, or jail-fever; and synochus, a mixed fever, commencing like the first, and terminating like the second. The intermittent family are defined as follows: Fevers arising from the miasm of marshy grounds, with an evident remission, the returning fits being almost always ushered in by horror or trembling. One paroxysm only in the day. The continued family are defined thus: fevers without intermission, not occasioned by marsh miasm, attended with exacerbations and remissions, though not very perceptible.

The remote causes of fever are not always to be easily or accurately distinguished, and of the proximate causes we may fairly be said to know nothing, since so many different conjectures, often in direct hostility to each other, have been offered, by writers of the first reputation, and the system of yesterday has so frequently fallen before that of today. Without entering therefore into this controverted subject, we shall proceed to an account of the general symptoms and mode of treatment.

Intermittents.—Symptoms. A regular paroxysm of this fever is divided into three stages—the cold, hot, and sweating stage.

The first stage commences with yawning and stretching; there is at the same time an uneasy sense of weariness, or inaptitude of motion, accompanied with some degree of debility; paleness and shrinking of the features and extremities are also observable; at this period some coldness of the extremities may be felt by another person, although the patient takes little or no notice of it; the skin, however, becomes rough, as is the case in cold weather, and is less sensible than usual; a sensation of coldness is now felt by the patient himself, which is at first referred to the back, and gradually spreads over the whole body, producing an universal shaking: after this has lasted for some time, the patient's sensation of cold still continuing, the warmth of his skin, to the feeling of another person, or measured by the thermometer, gradually increases; there is nausea, and frequently vomiting of a bilious matter; pains of the back, limbs, loins, and head-ach, or more commonly drowsiness, stupor, or a considerable degree of coma, attend this stage; the respiration is frequent and anxious; the pulse is small, frequent, sometimes irregular, and often scarcely perceptible; the urine is almost colourless, and without cloud or sediment.

As the cold and shivering, after alternating for some time with warm flushings, gradually abate, the hot stage is ushered in by a preternatural heat, the pulse becomes full, strong, and hard, the respiration is more free, but still frequent and anxious, the paleness and shrinking of the features, together with the constriction of the skin, now disappear, and are succeeded by a general redness and turgescence; the tongue is white and dry, the thirst is considerable, the skin continues parched, the head-ach, if it was absent in the first stage, now comes on, is accompanied with throbbing of the temporal arteries, and frequently rises to delirium, and the urine is high coloured; as the hot stage advances, the nausea and vomiting abate, and on the appearance of moisture upon the skin, they generally cease altogether. The hot stage is at length terminated by a profuse sweat, which breaks out, first about the face and breast; it gradually extends over the whole body, and terminates the paroxysm; most of the functions are restored to their natural state, the respiration becomes free, the urine deposits a lateritious sediment, the sweat gradually ceases, and with it the febrile symptoms: the patient is, however, left in a weak and varied state: between the paroxysms, the patient is more easily fatigued than usual, complains of want of appetite, and the skin is parched, or he is more liable to profuse perspiration than in health. The cold fit of this species is longer than that of the quotidian, but shorter than that of the quartan, and the whole paroxysm is shorter than that of the quotidian, but longer than that of the quartan.

The predisposing causes of intermittents are, whatever tends to debilitate the body, a warm moist, or cold damp atmosphere, particular seasons, as spring and autumn: the occasional or exciting causes are, marsh miasm, contagion, and perhaps lunar influence.

Prognosis. Mildness and regularity of the paroxysm, a general cutaneous eruption, or an eruption about the mouth and behind the ears, accompanied with a swelling of the upper lip, when the paroxysm is going off; a free hemorrhage from the nose during the paroxysm, and the urine depositing a lateritious sediment in the last stage, are favourable symptoms. Coma, delirium, great anxiety, difficult respiration, attended with hiccup, swelling of the tonsils, the abdomen tumid, hard, and painful to the touch, accompanied with obstinate costiveness, tension and pain in the epigastric and hypochondric regions during the paroxysm; listlessness, nausea, or debility, attended with vertigo in the intermissions, or a few drops of blood falling from the nose in the paroxysm, are unfavourable symptoms. Intermittents are frequently followed by, or attended with, obstructions in the different viscera, particularly in the liver and spleen; dropsy, dysentery, jaundice, and various species of inflammation.

Treatment. In the paroxysms we are to endeavour to shorten the different stages, and thus to obtain a final solution of the disease. In the intermissions we are to prevent the recurrence of the paroxysms, and endeavour to obviate certain circumstances, which may prevent the fulfilling of either of the two first indications.

The first indication will be accomplished by the administration of an emetic at the commencement of the paroxysm, or during the cold stage; for which purpose tartar emetic is the best; it should be given in divided, but pretty large doses, the patient should at the same time be put to bed, kept in warm blankets, and allowed warm diluent, but not stimulating liquors, except there is a considerable degree of debility; and immediately the hot stage is formed, a gentle diaphoresis will be excited, and a final solution of the paroxysm procured, by the exhibition of opiates, assisted by moderate draughts of tepid, or, if the heat be preternaturally great, of cold liquids, and by the neutral salts. In the intermissions, the bark should be administered in doses of a drachm or more, every one, two, or three hours, so that an ounce, or an ounce and a half, may be taken during the intermission; when the apyrexy is long, as in the tertian, its exhibition may be delayed till within six or eight hours of the time when the next paroxysm is expected, which will frequently more effectually prevent its return than when given in small doses during a long intermission; but if there be a great degree of debility, or where the intermissions are short, as in the quotidian, the bark should be employed immediately after the termination of the paroxysm, at longer or shorter intervals, until the return of the next fit, in such doses as the stomach will bear, and the urgency of the case may require: when this invaluable medicine purges, a few drops of the tincture of opium may be added; and if, on the other hand, it induce costiveness, a few grains of rhubarb will obviate it, and at the same time give tone to the stomach and bowels; it is sometimes of service to add about a scruple of snakeroot to each dose of the bark; where the stomach is habitually weak, it will be advisable to combine aromatics or bitters with the bark, as calamus, or canella alba, &c. The sulphate of copper may be employed in its usual dose: the oxide of arsenic combined with opiates, either in solution or in the form of pills, will frequently succeed, when bark and other remedies have been tried without effect. If the disease should prove obstinate, and any pain can be perceived by the patient upon pressing the right hypocondrium, small doses of the calomel, or friction with the unguentum hydrargyri, continued until a slight soreness of the mouth is induced, will, in general, be attended with the most beneficial effects, as its continuance is most commonly the consequence of obstructed viscera.

The circumstances which prevent our fulfilling the two first indications are, inflammatory diathesis, accumulation of bile in the stomach, and of that and fæces in the intestinal canal. The first circumstance will be removed by bloodletting; and if, curing the paroxysm, any urgent symptoms indicate the presence of that diathesis, it will be attended with the greatest prospect of success, if the operation is performed during the hot stage, when the excitement is most considerable: the latter causes will be removed by the administration of emetics and cathartics: if there be a great degree of debility, the system must be strengthened by a generous diet, the moderate use of wine, gentle exercise, the cold bath, and change of air. As in this disease relapses very frequently occur, it will not only be advisable, but necessary, to continue the use of the bark in doses of a drachm four times a day, for two or three weeks: at the same time the patient must most studiously avoid all the exciting causes, and every irregularity in diet. Vernal are less liable than autumnal intermittents to become continued fevers, and are rarely attended with alarming symptoms, or followed by dangerous obstructions. The taste of the bark will be concealed in a great measure, by exhibiting it in milk, buttermilk, or infusion of liquorice; and if the stomach should possess a considerable degree of irritability, opium, administered either by itself or combined with camphor, will, in general, succeed in enabling that organ to retain the bark. The paroxysm may be generally prevented by administering a full dose of the tincture of opium, in mulled wine or hot diluted spirits, about an hour previous to its expected return.

Continued Fever. This is either inflammatory (synocha); putrid or gaol (typhus); or mixed (synochus.)

Symptoms of Synocha. This fever, which, however, without topical inflammation, is in this country a very rare occurrence, generally commences with short fits of cold and heat alternating with each other, to which succeed an intense burning heat, head-ach, accompanied with throbbing of the temples, or tinnitus aurium, pains in the back, loins, and joints, and the patient feels as if his body had been severely bruised: the face is full and florid; the eyes are inflamed and incapable of bearing the light; the skin, mouth, and throat are dry; the tongue is covered with a white crust; the thirst is intolerable; the respiration is frequent, hurried, generally oppressed, and attended with a dry cough; there is anorexia, nausea, vomiting, restlessness, and delirium; the urine is secreted in small quantities, and is high coloured; the bowels are costive; the pulse is frequent, strong, and hard, scarcely ever, however, exceeding 120 strokes in a minute; the blood, when drawn, is covered with a whitish or yellowish crust. In this country, after the symptoms have continued for some days, they begin generally to assume those of typhus, so that the whole disease is synochus.

Causes. Suppression of the accustomed evacuations; cold, by any means applied, as exposure of the body to the cold air, when it is in a state of perspiration; exposure to the rays of the sun; intemperance in eating, but more particularly in drinking; topical inflammation; intense study; great fatigue; the premature repulsion of eruptions; perspiration suddenly checked; and violent passions of the mind.

Diagnosis. This fever will be readily distinguished from the typhus mitior by the strength of the pulse, the intense heat, great thirst, violent pains in the back and joints, high coloured urine, and by the less derangement of the mental functions.

Prognosis. It frequently terminates in a favourable manner about the seventh day, either by hemorrhage, a profuse diaphoresis, or by the urine depositing a copious lateritious sediment; the termination by diarrhœa is a much more rare occurrence. If the respiration be very laborious, if the head-ach be very severe, attended with delirium ferox, if the abdominal viscera be much affected, if the urine be pale or limpid, and the skin assumes a yellow tinge before the seventh day, we may generally expect an unfavourable issue.

Treatment. The removal of this disease must be attempted by blood-letting, in proportion to the violence of the symptoms of increased excitement, strength, and former habits of life of the patient, and nature of the prevailing epidemic; if, on the first blood-letting, the symptoms be considerably alleviated, and the pulse and heat become nearly natural, it will not be necessary to repeat it; if, on the contrary, the symptoms continue with but little or no abatement, it will not only be advisable, but indispensably necessary, to repeat the operation, until we nearly reduce the pulse and heat to the natural standard; the blood-letting will be the more efficacious, the more suddenly we abstract the blood; an emetic should then be administered, and in a few hours after its operation has ceased, a cathartic should be exhibited, for which purpose the phosphate or sulphate of soda, or the sulphate of magnesia, combined with the infusion of senna, with a small proportion of the tartarised antimony, will be the most efficacious; calomel is a preferable medicine to the others; after the contents of the primæ viæ are sufficiently evacuated, we should order the neutral salts, particularly the saline draughts, every two or three hours, to each dose of which, from twenty to thirty drops of antimonial wine, with the same quantity of the spirit of nitre, may be conjoined with advantage; cooling mucilaginous liquors, acidulated with the vegetable acids, or cold water, should be freely allowed, when the heat of the surface of the body is steadily above the natural standard. It is of the utmost consequence, throughout the whole course of this disease, that the alimentary canal should be kept clear of feculent matter; for which purpose the mildest laxatives should be employed, or perhaps mucilaginous clysters would be preferable; all exercise, both of the body and mind, must be studiously avoided, the patient must be kept quiet and in a horizontal posture, the light should be as much as possible excluded, there should be a free circulation of cool air through the apartment, the floor of which should be frequently sprinkled with cold water, the patient should be lightly covered with bed-clothes, all excremental matters should be speedily removed, and the patient should have frequent changes of dry linen. If the pain of the head be very violent, accompanied with delirium, or if the patient is oppressed with coma, blood-letting, both general and topical, will be necessary, provided the strength of the patient is not too much exhausted; cathartics and laxative clysters must be ordered, the head should be shaved, and cooling applications, as vinegar and water, or, a solution of the volatile salt of hartshorn in vinegar, and the like, must be employed; blistering the head, and fomenting the lower extremities, will also be of service. If the respiration should be much oppressed, and attended with a short dry cough, we must immediately have recourse to blood-letting, both general and local; blisters should be applied to the thorax, and we should direct a liberal use of mucilaginous diluents. Should the abdominal viscera be attacked in the course of the disease, the same general means of blood-letting and blistering must be employed, together with laxatives or fomentations of the lower extremities. In this climate, after a short period, the symptoms generally begin to assume the typhoid form, therefore some degree of caution will be indispensably necessary in the liberal employment of evacuations, lest we should induce a degree of fatal debility.

Typhus.—Symptoms. An uneasy and peculiar sensation in the stomach, sometimes attended with nausea and giddiness, frequently denotes the approach of this fever. In many cases, however, it is scarcely or not at all perceived, and the disease generally commences with lassitude, languor, some degree of debility, horripilatio or sense of creeping, impaired appetite, alternate and irregular heats and chills, anxiety about the præcordia, and great dejection of spirits, accompanied with frequent sighing. After these symptoms have continued for a few days, the patient is attacked with head-ach, or an uneasiness and confusion of head; a deep-seated pain, or a sensation of coldness, is perceived, particularly in the occiput; there is nausea, vomiting of insipid phlegm, and great prostration of strength; the heat of the body is but little increased; there is little or no thirst; the tongue at the commencement of the disease is moist, and covered with a white crust; in the more advanced stages it becomes dry, brown, and chapped; the countenance is pale and sunk, the pulse is small, weak, and frequent, the respiration is oppressed, and attended with great anxiety about the præcordia, the urine is pale, and secreted in too great a quantity. The uneasiness and confusion of head increase with the debility, and prevent the patient from going to sleep; or if he do, it does not refresh him, and on the second or third night some degree of delirium comes on, which, however, goes off in the morning, and returns in a more severe manner every evening, and during the day he lies in a confused state, or is constantly muttering to himself. All these symptoms go on gradually increasing, followed by tremor of the hands and tongue, muscæ volitantes, picking of the bed-clothes, subsultus tendinum, and convulsions, which generally close the scene.

Causes. The depressing passions of fear, grief, and despair; all excessive evacuations; a relaxed habit of body; immoderate venery; a sedentary and studious life; intemperance in eating and drinking; fatigue; the abstraction of the usual quantity of nourishing food; contagion, and paucity of blood.

Diagnosis. The slow and insidious appearance of this fever will distinguish it from the typhus gravior: the rigours are less severe; there is a considerably less degree of heat and thirst, and no bilious vomiting; there is also greater mildness in the symptoms, even in the first stage; the skin is pale, and has a bluish and sunk appearance.

Prognosis. The favourable symptoms are, an universal warm moisture of the skin; the tongue from being dry and foul becoming moist; the pulse being rendered more slow and full after a gentle diaphoresis, or the exhibition of cordials; the appearance of an eruption about the lips and nostrils; a miliary eruption, neither preceded by, nor accompanied with, profuse sweating; deafness; a temporary insanity; an increased secretion of saliva without aphthæ; a spontaneous but gentle diarrhœa. The unfavourable symptoms are, a great degree of muscular debility; the early appearance and obstinate continuance of delirium; stupidity and listlessness of the eyes on the first days of the disease; a morbid sensibility of the surface, and of all the organs of sense; profuse evacuations, attended with a weak pulse; tremor of the hands and tongue; feather-hunting; a considerable degree of sighing, mumbling, and moaning; constant watchfulness; coma, accompanied with fulness of the vessels of the tunica adnata, and dilated pupils; a difficulty of swallowing, attended with hiccup; an unconscious discharge of the urine and fæces. Dr. Fordyce observes, in his third Essay on fevers, p. 111, that, if the respiration and deglutition be free, the prognosis is seldom bad, although the disease may be attended with alarming symptoms.

Treatment. The first step to be taken in this, as well as in most other febrile diseases, is, to clear the primæ viæ of their crude and acrid contents, by the early exhibition of an emetic, which, by the concussion it gives to the whole system, dissolves the morbid catenation, and frequently terminates the disease; in a few hours after that has ceased to operate, a cathartic of calomel should be administered, mixed with a small quantity of conserve, honey, or mucilage, and it should be allowed to remain for a short time about the fauces before it is swallowed; throughout the whole course of the disease we must procure the regular expulsion of the fæces, by means of the mildest laxatives, or by the injection of clysters every evening; the skin on every part of the body successively should be washed with cold water, or vinegar and water; wine and opium should be administered in small quantities, and repeated every three hours alternately; the application of small repeated blisters will be of considerable service; the administration of oxygen gas will also prove an useful auxiliary. The symptoms which forbid the use of bark are, a hot and dry skin, and a parched tongue; it must, therefore, be our object of practice to remove those symptoms as early as possible, which will in general be accomplished by the administration of the saline draughts in a state of effervescence, every two, three, or four hours, combined with the infusion or tincture of snake-root, with from twenty to thirty drops of æther in each draught; warm pediluvia should be ordered in the evenings, or the lower extremities should be fomented; whenever a general relaxation of the skin occurs, the bark, combined with a small portion of the confectio opiata, and a few drops of the muriatic or sulphuric acid in each dose, should be given frequently, taking care at the same time not to oppress the stomach. A table-spoonful of yeast, either diluted or in its pure state, has been of late much employed, and with a considerable degree of success; it should be given at least three or four times in the course of the day. At bed-time it will be proper to give an opiate, particularly if the patient is restless, and its effects will be promoted by combining it with about ten grains of the castor or camphor, or from fifteen to twenty grains of the compound powder of ipecacuanha, or a drachm of Hoffman's æther may be substituted, the last of which medicines, if it does not procure sleep, it does not, however, increase the heat or restlessness: if the hands and feet be at that time parched, the effects of the opium or other remedies will be promoted by moistening them with cold or tepid vinegar. , If the head-ach be very distressing, blisters should be applied to the temples: should subsultus tendinum supervene, either æther, camphor, carbonate of ammonia, castor, or the musk, should be administered in large doses alternately with bark: the diet should be light and nourishing; bottled porter and wine should be allowed liberally, taking particular care that not the smallest degree of intoxication ensues: sedative and antispasmodic remedies may also be employed externally by means of friction; they have in many instances produced the most happy effects

Dr. Currie, in his ingenious and valuable work, entitled "Medical Reports on the Effects of Water in Fevers and other Diseases," vol. i. p. 17, *et seq.* observes, when speaking of the aspersion or affusion of cold water, vinegar and water, or of a saturated brine, "that the safest and most advantageous time for using either the aspersion or affusion (the latter of which he prefers), is when the exacerbation is at its height, which is marked by increased flushing, thirst, and restlessness, or immediately after its declination is begun; and this has led me almost always to direct it to be employed from six to nine o'clock in the evening; but it may be safely used at any time of the day, when there is no sense of chilliness present, when the heat of the surface is steadily above what is natural, and when there is no general or profuse sensible perspiration. It is at the same time highly necessary to attend to the precautions which the employment of this valuable remedy requires: 1. If the affusion of cold water on the surface of the body be used during the cold stage of the paroxysm of fever, the respiration is nearly suspended, the pulse becomes fluttering, feeble, and of an incalculable frequency; the surface and extremities become doubly cold and shrivelled, and the patient seems to struggle with the pangs of instant dissolution. I have no doubt, from what I have observed, that in such circumstances the repeated affusion of a few buckets of cold water would extinguish life. This remedy should, therefore, never be used when any considerable sense of chilliness is present, even though the thermometer, applied to the trunk of the body, should indicate a degree of heat greater than usual. 2. Neither ought it to be used when the heat, measured by the thermometer, is less than, or even only equal to, the natural heat, though the patient should feel no degree of chilliness. This is sometimes the case towards the last stages of fever, when the powers of life are too weak to sustain so powerful a stimulus. 3. It is also necessary to abstain from the use of this remedy, when the body is under profuse sensible perspiration, and this caution is more important in proportion to the continuance of this perspiration. In the commencement of sweating, especially if it has been brought on by violent exercise, the affusion of cold water on the naked body, or even immersion in the cold bath, may be hazarded with little risk, and sometimes may be resorted to with great benefit. After the sweating has continued some time, and flowed freely, especially if the body has remained at rest, either the affusion or immersion is attended with danger, even though the heat of the body at the moment of using it be greater than natural. Sweating is always a cooling process in itself, but in bed it is often prolonged by artificial means, and the body is prevented from cooling under it to the natural degree by the load of heated clothes. When the heat has been thus artificially kept up, a practitioner, judging by the information of his thermometer only, may be led into error. In this situation, however, I have observed, that the heat sinks rapidly on the exposure of the surface of the body even to the external air, and that the application of cold water, either by affusion or immersion, is accompanied by a loss of heat and a deficiency of re-action, which are altogether inconsistent with safety." Under these restrictions, the cold affusion may be used at any period of fever, but its effects will be more salutary in proportion as it is used more early When employed in the advanced stages of fever, where the heat is reduced and the debility great, some cordial should be given immediately after it, and the best is warm wine. Dr. Currie, when speaking of the internal use of cold water, vol. i. p. 92, *et seq.* directs that "1. Cold water is not to be used as a drink in the cold stage of the paroxysm of fever, however urgent the thirst. Taken at such times, it increases the chilliness and torpor of the surface and extremities, and produces a sense of coldness in the stomach, augments the oppression on the præcordia, and renders the pulse more frequent and more feeble. 2. When the hot stage is fairly formed, and the surface is dry and burning, cold water may be drank with the utmost freedom. Frequent draughts of cold liquids at this period are highly grateful; they generally diminish the heat of the surface several degrees, and they lessen the frequency of the pulse. When they are attended with these salutary effects, sensible perspiration and sleep commonly follow. Throughout the hot stage of the paroxysm, cold water may be safely drank, and more freely in proportion as the heat is further advanced above the natural standard. It may even be drank in the beginning of the sweating stage, though more sparingly. Its cautious use at this time will promote the flow of the sensible perspiration, which, after it has commenced, seems often to be retarded by a fresh increase of animal heat. A draught of cold water taken under such circumstances will often reduce the heat to the standard at which perspiration flows more freely, and thus bring the paroxysm to a speedier issue. 3. But, after the sensible perspiration has become general and profuse, the use of cold drink is strictly to be forbidden. At this time I have perceived, in more than one instance, an inconsiderate draught of cold water produce a sudden chilliness, both on the surface and at the stomach, with a great sense of debility, and much oppression and irregularity of respiration. At such times, on applying the thermometer to the surface, the heat has been found suddenly and greatly reduced. The proper remedy is, to apply a bladder filled with water heated from 110° to 120° to the pit of the stomach, and to administer small and repeated doses of laudanum."

Dr. Cullen divides this disease into two varieties; typhus mitior, or low nervous fever, being that we have now described; and typhus gravior, jail, camp, or hospital fever, far more violent in its symptoms, rapid in its progress, infectious in its effluvium, and fatal in its tendency. It becomes the medical practitioner, therefore, to be proportionably more bold and active: with which general observation, the same mode or treatment may for the most part be pursued. The stimulant plan must be pushed to a much greater extent, and affusions of cold water are here of more use than in the preceding variety, and of course ought to be employed with the most liberal and unhesitating attention.

Synochus.—Symptoms. This, as we have already observed, is a fever compounded of those that characterise the first stage of synocha, or inflammatory fever, with which it commences, and of those which constitute the middle and last stages of typhus or putrid fever, into which it becomes converted by a sudden and oftentimes a very unexpected change. It is a common fever in the large manufacturing towns of this country; and great care is necessary, on its first appearance, that it be not mistaken for, and consequently treated as, an inflammatory attack, by venesection, and a strict debilitating plan. This is the general caution on its commencement, or while we are in doubt; in its further advance, the treatment must be adapted to the different symptoms it exhibits, as more nearly approaching to the nature of the synocha or typhus, and should be governed by the regulations already laid down for the treatment of these diseases.

Under this genus Dr. Cullen has ranged hetic fever: whilst he makes phthisis, of which he admits it to be only a symptom, under a genus of another order, which he denominates hæmorrhagiæ. It cannot, therefore, be considered as entitled to any notice in the present place, and we shall consequently transfer it to that to which it more properly belongs.

ORDER II. *Phlegmasiæ*. INFLAMMATIONS.

Topical inflammations, or phlegmasiæ, are a very numerous assemblage of diseases: their chief characteristics are, the general symptoms of fever, and a topical inflammation, attended with the lesion of some important function; in which, usually after blood-letting, the blood is found upon coagulation to be covered with a buffy coat. This order comprehends the following eighteen genera: 1. Phlogosis, of which, upon the Cullenian system, there are two species; P. phlegmon, and P. erythema, or cutaneous erysipelas. 2. Ophthalmia, inflammation of the eyes. 3. Phrenitis, inflammation of the brain. 4. Cynanche, the sore throat, or quinsy. 5. Pneumonia, inflammation of the lungs. 6. Carditis, of the heart. 7. Peritonitis, of the peritonæum. 8. Gastritis, of the stomach. 9. Enteritis, of the intestinal canal. 10. Hepatitis, of the liver. 11. Splenitis, of the spleen. 12. Nephritis, of the kidnies. 13. Cystitis, of the urinary bladder. 14. Hysteritis, of the womb. 15. Rheumatismus, rheumatism. 16. Odontalgia, inflammatory toothach. 17. Podagra, gout. 18. Arthropuosis, inflammation of the hip.

By far the greater number of these are of the same natural family, and require the same mode of treatment; and several we have already noticed in the article DIETETICS. Whatever be the organ affected, with the very few exceptions we shall presently point out, the inflammation must be attacked with applications both general and topical, and powerful in proportion to the degree of inflammation. Venesection, cathartics of calomel, and laxative injections, may be safely recommended as a part of the general practice. Local bleeding by cupping, wherever it can be employed, and where it cannot, by leeches, should constitute an essential feature of the plan, and be repeated according to the urgency of the symptoms. In most of these diseases benefit may also be obtained by frigid lotions, as of common spring water, ice water, vinegar; while the general symptomatic fever, if considerable, must be attacked by the process of cure already laid down in the treatment of fevers, and varied according to the phænomena that arise. When the cause is obvious, as in many cases of ophthalmia, or inflammation of the intestines, we should be indefatigable till it be removed, since without the accomplishment of this point every thing else must be of no avail. These are general hints. Several of the diseases, however, arranged under this order are connected artificially alone, and not naturally, and require a distinct treatment. We shall briefly notice a few of them.

Erythema. As in this affection, notwithstanding the inflammatory appearance, there is frequently a considerable degree of debility, we must not push the antiphlogistic measures too far, particularly in debilitated habits, and in those advanced in life, for fear of inducing gangrene, but rather trust to wine, bark combined with snake-root or camphor, and the sulphuric acid, together with local applications. Should there, notwithstanding all our efforts, be a tendency to gangrene, we should stimulate in a still higher degree; on the other hand, should there be any considerable danger of excitement, which, however, is rarely the case, accompanied with a hard, full, and strong pulse, blood-letting, repeated according to the violence of the symptoms and effects produced, will be necessary; at the same time, it will be advisable to employ gentle cathartics: but the bark will usually be found the most efficacious remedy in every stage of this disease.

Cynanche, Quinsy. Of this genus the Cullenian system makes five species. 1. C. tonsillaris, common inflammatory sore throat. 2. C. maligna, malignant sore throat, chiefly symptomatic of scarlet and other fevers of a putrid tendency. 3. C. trachealis, croup; a disease most commonly of infancy. 4. C. pharyngea, a mere variety of C. tonsillaris, by its being extended to the pharynx. 5. C. parotidæa, mumps; generally a slight inflammatory affection, and lasting only a few days, of the parotid and maxillary glands; though sometimes succeeded in men by symptomatic intumescence of the testes, and in women induration of the mammæ, usually, however, yielding to repellent applications and gentle aperients. If the head be affected by stupor, or delirium, from a similar sympathy, it should be bathed with warm water; and a few ounces of blood, according to the strength of the patient, should be taken from the arm.

Generally speaking, indeed, the common means employed in the removal of other local inflammations, with the use of acid gargles, is the plan to be adopted in Cynanche; yet the two following species require to be noticed separately.

C. trachealis. This disease very rarely attacks infants until after they have been weaned; it generally commences with a sensation of uneasiness, or somewhat of an obtuse pain about the upper part of the trachea, which is increased on pressure, or a sense of constriction is perceived in the neighbourhood of the larnyx; upon inspecting the fauces, little or no tumour is generally observed; sometimes, however, there is some trifling degree of redness; a hoarseness, and particular ringing shrill sound of the voice, accompanies both speaking and coughing; the noise appears to proceed as from a brazen tube, and has been not inaptly compared to the crowing of a cock; there is dyspnœa, attended with a wheezing sound in the act of inspiration; the cough which attends the disease is commonly dry and short; if any thing be expectorated, it is putriform, and mixed with small portions of a whitish membrane, similar to what is found in the trachea upon dissection, which is, by that illustrious anatomist and physician, Dr. Baillie, supposed to be formed by some peculiar action of the blood-vessels of the inner surface of the larynx and the trachea, which is superadded to inflammation; the face is somewhat livid, or is flushed. With these symptoms there is some degree of frequency and hardness of the pulse, great thirst, restlessness, and an unpleasant sense of heat; the deglutition is but little or not at all affected; the urine, at the commencement of the disease, is generally high coloured; sometimes, however, it is limpid; but in the advanced stage it is turbid: there is seldom any delirium; sometimes, however, the patient seems stupid, and mutters to himself, and often in the perfect use of his senses he is seized with great difficulty of breathing, and a sense of strangling about the fauces, and is suddenly carried off. This disease chiefly appears in the winter and spring; it generally attacks the most robust and ruddy children, and frequently comes on with the ordinary symptoms of catarrh. The remote causes are, cold, combined with a moist state of the atmosphere; infancy; exposure to air passing over large bodies of water, and many of the causes producing the Phlegmasiæ, and the other species of Cynanche. It is said to be most frequently met with in marshy situations, and near the coast. The proximate cause appears to consist in an inflammation of the inner coat of the trachea and the larynx, together with an altered and peculiar action in the blood-vessels of the parts; and the adventitious membrane is the consequence.

Treatment. We must attempt the cure of this disease by the remedies which are recommended for the removal of inflammation; blood-letting, both general and topical, must be immediately had recourse to, and it must be repeated according to the strength of the patient, violence of the symptoms, state of the pulse, and the effects produced from it: repeated emetics should be administered, and mild cathartics or laxative clysters should be at the same time employed; blisters should be applied to the external fauces, or stimulating liniments, as the liniment of ammonia with oil of amber and tincture of cantharides, should be made use of; the warm bath should be ordered, and the vapour of warm water, with or without a portion of vinegar, should be frequently received into the fauces; in every stage of the disease the antiphlogistic regimen is peculiarly necessary, and the patient should lie with his head raised high in bed: small repeated doses of calomel have been administered with the best effects, at the commencement and throughout the whole course of the disease, as two or three grains two or three times in the course of the day. This disease sometimes attacks adults; in which case the most powerful remedies against inflammation, together with the employment of emetics, must be immediately had recourse to, and persevered in with assiduity. There appear to be two varieties of this complaint; the one just now described, which may be termed the inflammatory, and the spasmodic; which, from their different requisite mode of treatment, it will be necessary to discriminate. The inflammatory Cynanche commonly attacks the patient in a gradual manner, and is generally preceded for a few days by slight symptoms of pyrexy; it never, when completely formed, intermits so as to lose its distinguishing mark, particularly in coughing: the heat, frequency of the pulse, and other symptoms of pyrexy, are in a much greater degree in this than in the spasmodic species. The spasmodic Cynanche always attacks the patient in a sudden manner, and usually in the night-time: it often intermits, and in the intervals both the respiration and cough, if any exists, are free from the characteristic sound of the above disease; it must, of course, be treated with antispasmodics, as the musk, camphor, asafœtida, the warm bath, and similar remedies.

C. maligna, malignant, or putrid sore throat. This disease, whether primary or symptomatic, is marked by frequent cold shiverings, alternating with fits of heat, giddiness, lassitude, anxiety, depression of spirits, nausea, and vomiting: these symptoms seldom continue long, before the patient complains of a sense of stiffness in the neck, some uneasiness in the internal fauces, and hoarseness; the internal fauces, when viewed, appear of a dark red colour, are but little or not at all swollen, and deglutition is seldom attended with difficulty or pain. In a short time, a number of white, ash-coloured, or brown spots make their appearance upon the inflamed parts; these spread, run together, and cover the greatest part of the fauces with thick sloughs, which, upon falling off, discover deep ulcerations. As the disease advances, these symptoms are generally attended with a coryza, which pours out a thin, acrid, and fetid matter, which excoriates the nostrils, lips, and sometimes every part it touches; in infants diarrhœa is a more frequent occurrence than in adults, and the thin acrid matter evacuated excoriates the anus and neighbouring parts. The fever increases with the other symptoms; the skin is dry, parched, and accompanied with a biting heat; the eyes become red, heavy, and watery; the countenance is either full and bloated, or pale, shrunk, and dejected, and the patient frequently complains of an unusual sense of oppression and debility; the pulse is small, frequent and irregular; the respiration is more or less hurried; and as the disease advances, the breath becomes very fetid, and is often disagreeable to the patient himself; and there is generally a considerable discharge of a sanious-like matter from the fauces; the voice is frequently very much altered, and when the inflammation has attacked the organs of respiration, it assumes a wheezing or ringing sound, the respiration becomes difficult, and the patient is teased with a troublesome cough; the fever suffers an evident exacerbation in the evening, during which some rattling is perceived in the breathing, and there is generally a remission in the morning; great debility, prostration of strength and restlessness, accompanied with frequent sighing, as in the Typhus Gravior, supervene, and, if neither delirium nor coma appeared at an early period, they generally come on in the progress of the complaint. On the second or third, rarely later than the fourth day, an eruption appears upon the skin, which, for the most part, in the first instance, shews itself upon the neck and breast. it comes out in blotches of a dark purple or raspberry hue, and gradually spreads over the trunk and extremities; the scarlet redness is often considerable on the hands and extremities of the fingers, which feel stiff and swelled; the stains, when nearly inspected, appear to be composed of small prominences, which may sometimes, although rarely, be distinguished by the eye, more frequently by the touch only; the eruption is as irregular in its appearance as it is in its steadiness and continuance; it generally, however, disappears about the fourth day. and a desquamation of the cuticle takes place; but neither on its first appearance, nor on its desquamation does it always produce a remission of the fever or of the other symptoms, except the vomiting, which generally abates on its first appearance. As the disease advances, the ulcers on the fauces become of a livid or black colour, the pulse becomes more depressed, and the symptoms attending the latter stages of the Typhus Gravior come on, and the patient is generally cut off, either by a diarrhœa, or by a profuse hæmorrhage from the intestinal canal, nose, mouth, or ears, often on the third day, sometimes later, but for the most part before the seventh. The complaint sometimes spreads into the trachea; the parotid and the other lymphatic glands also in the vicinity of the fauces, in consequence of the absorption of the putrescent matter, are sometimes so much swollen as to endanger or induce suffocation.

Causes. This disease is produced by a specific contagion, and those will be more liable to be attacked by it who are of a sickly habit of body, and who have been exposed to the remote causes of the Typhus Gravior. It has been frequently observed of this, as of most other epidemics, that it is most fatal on its first appearance, gradually becoming milder till towards the end, when it is attended with scarce any danger; at the same time, other complaints seldom prevail much while it rages, or, if they do, are generally catenated with its symptoms.

Treatment. In the management of this often fatal and insidious disease, we must keep its tendency to depression of strength and gangrene constantly in view, and at the same time attend to certain troublesome symptoms which frequently accompany this disease. Emetics, at the commencement, must on no account be dispensed with; but as in this species of Cynanche there is so great a tendency to diarrhœa, they should in general consist of ipecacuanha only: sometimes, however, a small portion of Dr. James's powder may be added with advantage. The intestinal canal must be evacuated by the most gentle laxatives, for which purpose the mercurial carthartics are particularly recommended; in the more advanced stages of the disease they will be improper, as there is generally a spontaneous diarrhœa: the regular expulsion of the fauces should be solicited by clysters only; but towards the termination, when the bowels are loaded with putrid sordes, accumulated in them during the disease, which protracts the fever and impairs the appetite, gentle cathartics will be serviceable: even in this case we must not venture to employ them, unless the fauces have a healthy appearance, and there is a considerable abatement of the febrile symptoms. Small repeated blisters should be applied to the external fauces: rubefacients, however, may in general be employed with equal advantage and more safety. The fauces must be preserved from the effects of the acrid matter discharged from the ulcers by the diligent use of antiseptic, or rather stimulating gargles, as the decoction of bark with muriatic or sulphuric acid, or the bark in port wine, a small quantity of which should be frequently employed or injected into the fauces by means of a syringe: a small quantity of a gargle, composed of alum, in the proportion of an ounce to a pint of water, is recommended to be frequently injected into the fauces, which is said to remove the fetor from the ulcers. But the most powerful gargle is prepared by mixing a tea-spoonful or two of the capsicum annuum, or Guinea pepper, and a tea-spoonful of sea-salt, with three ounces of distilled vinegar, and the same quantity of boiling water, a small quantity of which is advised to be taken into the fauces every two hours, so as to produce and keep up a moderate degree of excitement on the tonsils, uvula, and fauces. Wine, opium, bark, mineral acids, and the other remedies recommended in the treatment of the Typhus Gravior, must be employed with assiduity. As children can rarely be prevailed upon to take the necessary medicines in sufficient quantities, the bark and cordials should be exhibited by clysters. Diarrhœa is to be checked by opiates and astringents, excepting it arise as a salutary crisis towards the close of the disease, in which case rhubarb in gentle doses is the very best moderating remedy

Rheumatismus, Rheumatism. Of this disease, there are two species, the *Acute* and the *Chronic*. The former generally commences with the usual symptoms of fever, preceded or succeeded by acute and pungent pains in the joints: the pain is not, however, confined to the joints; but it frequently shoots along the muscles from one joint to another: the parts most commonly affected are the hips, knees, shoulders, and elbows, more rarely the ankles and wrists: the pain is much increased upon the slightest motion, or even by the heat of the bed: there is some degree of swelling and redness in the parts most affected, which are painful to the touch: the pulse is frequent, full, and hard: generally costive: the urine at the commencement of the disease is high-coloured, and generally without sediment; but on the remission of the symptoms it deposits a lateritious one, and there is a tendency to sweating in the course of the disease, which rarely brings relief: an exacerbation of the febrile symptoms takes place every evening, and a remission towards morning, and the pains are most severe and most apt to shift their place in the night-time. Dr. Darwin suspects that rheumatism is not a primary disease, but the consequence of the translation of morbid action from one part of the system to another, which idea, he observes, is countenanced by the frequent change of place in rheumatic inflammation, and from its attacking two similar parts at the same time, as both ankles and both wrists, and these attacks being in succession to each other· and he further remarks, that this accounts for rheumatic inflammation so very rarely terminating in suppuration, as the original cause is not in the inflamed part; but, instead of suppuration, a quantity of mucus or coagulable lymph, is formed on the inflamed membrane, which is re-absorbed, or lies on it, producing pains on motion long after the termination of the inflammation.

The remote *causes* of this disease are, frequent vicissitudes of the weather; cold suddenly applied to the body when under perspiration; the long continued application of cold, particularly when combined with moisture, as when damp or wet clothes are applied to the body or extremities, for any considerable length of time; plethora; cold caught when the system is under the influence of the hydrargyrus; certain seasons of the year, as spring and autumn. The proximate cause is supposed to be an inflammation of the membranes and tendinous aponeuroses of the muscles.

The *cure* of this species of the disease will be effected by removing the morbid excitement, by a strict adherence to the antiphlogistic regimen, by blood-letting, which must be repeated in proportion to the degree of strength and hardness of the pulse, and violence of the symptoms: we must not, however, push general evacuations too far, as they not only retard the recovery of the patient, but frequently induce an obstinate chronic state of the disease: topical evacuations, by means of leeches or cupping, may, after general blood-letting, be advantageously employed when the pain becomes fixed in the joints, attended with some degree of redness and swelling: gentle saline or mercurial cathartics, or laxative clysters, should be frequently administered; a gentle diaphoresis should be excited by means of the neutral salts, or of saline draughts combined with nauseating doses of tartarised antimony and the sulphuric or nitrous spirit of æther or camphor, may be employed in combination with volatile salt of hartshorn; cooling mucilaginious diluents are to be taken freely: the diet should consist of food of little stimulus, and the cure will be further promoted by the warm bath. When the excitement has been subdued, bark, combined with chalybeates, and myrrh or opiates, combined with ipecacuanha, may be administered with great advantage: rubefacients are of service, and blistering should be employed when the excitement is considerably reduced, and the pain is much confined to one part. Bark has of late been recommended to be administered in every stage of the disease, and there is no doubt that it may be employed, not only with great propriety, but with safety, if the pain be attended with distinct remissions, and assumes more or less the form of an intermittent; when the excitement, however, is considerable, it will be advisable to premise some general evacuations.

The remote *causes* of *Chronic Rheumatism* are, preceding acute rheumatism, cold applied partially to the body when heated, and most of the causes producing the other species. The proximate cause is supposed to be atony of the blood-vessels and muscular fibres of the part affected, together with some degree of rigidity and contraction in those fibres: and the removal of this complaint must be attempted by restoring the activity and vigour of the part affected, and also that of the system in general, by the usual remedies for this purpose; and especially by the use of guaiacum and other warm resins, mustard-seed, and horse-raddish; with a local application of volatile liniments and the flesh-brush. The warm bath, or Buxton waters, may also be employed with advantage.

Podagra.—Gout. Of this disease there are four species or varieties, the regular, atonic, misplaced, and retrocedent; it is not necessary, however, to dilate upon each separately.

This disease sometimes makes its attack without any previous warning: in general, however, the inflammation of the joint is for some days preceded by great langour and dulness both of body and mind, doziness, giddiness, wakefulness, or unrefreshing sleep, wandering pains, a deficiency of moisture in the feet, and there is sometimes a coldness, numbness, and sense of prickling, in the feet and legs: these symptoms are often, in a greater or less degree, accompanied with frequent cramps of the muscles of the legs and toes, and universal turgescence of the veins, occasional chills, acidity and flatulence in the stomach, and an increased or impaired appetite. The appetite is, however, frequently more keen than usual on the day preceding the attack of the fit. On going to bed the patient enjoys his usual natural sleep until about two or three o'clock in the morning, when he is awakened by a very acute pain, most commonly in the first joint of the great toe: sometimes, however, it attacks other parts of the foot. The pain resembles that of a dislocated bone, and is attended with the sensation as if all but cold water was poured upon the part. There is at the same time more or less of a cold shivering, which abates as the pain increases in violence, and is succeeded by a hot fit. The pain, from the commencement, gradually becomes more violent: it is sometimes so acute, as to be compared to a dog gnawing the part, and that and the fever continue in the same state, accompanied with great restlessness, till next midnight, when they gradually remit, and after a continuance of twenty-four hours from the commencement of the paroxysm, they commonly cease entirely: the patient falls asleep, during which a gentle perspiration generally comes on, and on waking he finds the part affected somewhat red and swelled. For some days the pain and fever return in the evening, but with a less degree of violence, and a remission takes place towards morning; and after these symptoms have continued for about ten or fourteen days, gradually becoming less severe, they generally cease altogether. Costiveness, an impaired appetite, chilliness of the body towards evening, are also to be reckoned among the symptoms of this disease.

The indications of cure are, in the paroxysms, to moderate their violence and shorten their duration as much as can be done with safety; and in the intervals to prevent the return of the paroxysms, or to render them less frequent and more moderate. The violence of the paroxysm will be moderated by blood-letting, which must be repeated according to the state of the pulse and degree of excitement, where the constitution is not worn down by repeated attacks; leeches should be applied to the inflamed parts, and gentle cathartics should be administered: these parts should also be exposed to cool or cold air, and diluting liquids should be taken freely: the antiphlogistic regimen must be strictly adhered to: abstinence from wine, spirits, fermented liquors, and stimulating food, should be carefully enjoined, unless the system is very much debilitated; in which case a more nourishing diet, and a small quantity of wine or of diluted spirits, may be allowed: after the excitement has been subdued by proper evacuations, blisters may be employed with advantage; they are recommended by that enlightened physician Dr. Rush, to be applied to the legs and wrists: burning with moxa may be advised, or a cabbage leaf applied to the part affected will often afford considerable relief; bootlets made of oiled silk are an useful application to gouty joints: when the violence of the symptoms is abated, opiates may be given with advantage, when the pain only returns during the night, and prevents sleep. When the constitution is broken down by repeated attacks of the disease, evacuations must be employed with caution, and it will in general be more advisable and safe to allow some animal food, and wine or diluted spirits: the parts affected should at the same time be wrapped in flannel, fleecy hosiery, or new-combed wool, and a gentle diaphoresis should be excited. When a swelling and stiffness remain in the joints, after the paroxysm has ceased, they will be removed by the diligent use of the flesh-brush, gentle exercise of the parts, and the Buxton or Bath waters, taken at the fountain head; and where the gout has left a number of dyspeptic symptoms, the latter may be drank with considerable advantage. Purging immediately after a paroxysm will be very apt to induce a relapse. In the intervals we must endeavour to prevent a return of the paroxysms, or to render them less violent: 1. By temperance, which should be regulated according to the age, habits of life, and constitution of the patient. It is very probable that a diet, consisting of milk, vegetables, and water, would prevent the recurrence of the disease: but in general fish, eggs, the white meats, and weak broths, may be taken in small quantities once a day, and a little salted meat may be eaten occasionally, and weak wine and water, or small beer, may be taken at meals. As there is a disposition in the gout to return in the spring and autumn, a greater degree of abstinence in eating and drinking will be necessary at those seasons than at any other period: and if any of the premonitory symptoms are then present, and the vigour of the system remains unimpaired, the disease may be often prevented from occurring by the loss of a few ounces of blood, or perhaps by an emetic or a gentle cathartic, and afterwards bathing the feet in warm water: a full dose of the tincture of opium might probably be of service. In the decline of life, or when the constitution is much debilitated, this abstemious mode of living must be commenced with caution, as it might be the means of inducing more violent and dangerous fits of the gout. 2. By moderate labour and gentle exercise, as riding on horseback; but more particularly walking. 3. By avoiding cold, especially when it is combined with moisture. The feet should be kept constantly warm and dry, by means of socks and cork-soled shoes, and the patient should wear flannel next to the skin. 4. By the prevention of costiveness, by means of gentle laxatives, as aloetics combined with soap and rhubarb, or oil of castor. 5. By tonics, as the bark, quassia, and chalybeates. 6. By the exhibition of alkalies in various forms, as the fixed alkali, both mild and caustic, lime water, soap, and the absorbent earths; and, lastly, by studiously avoiding the exciting causes. In the retrocedent species, strong stimulants, both external and internal, should be instantly employed with an unhesitating hand; and in the atonic species, the diet should be peculiarly generous, and compounded of spices and other aromatics.

ORDER III. *Exanthemata.* ERUPTIVE FEVERS.

These consist of the following genera: 1. Erysipelas, or St. Anthony's fire. 2. Pestis; plague. 3. Variola; small-pox. 4. Varicella; chicken-pox. 5. Rubeola; measles. 6. Miliary; miliary fever. 7. Scarlatina; scarlet fever. 8. Urticaria; nettle-rash. 9. Pemphigus; bladdery fever. 10. Aphthæ; thrush. The whole of this order is defined by Cullen to consist of diseases affecting persons only once in their life, commencing with fever, and succeeded by phlogoses, generally small in size, considerable in number, and dispersed over the skin. The definition, however, will not hold good in several of its clauses, and especially in its first; for, perhaps, there is not a single disease in the list, but what has occasionally recurred, and many of them repeatedly. It is to be remarked, through the whole of these, that, whatever danger may accompany them depends rather upon the degree of fever, and the nature of the fever that introduces them, than upon the extent or nature of the eruptions themselves: and hence, with very few exceptions, the general plan laid down for the treatment of the different genera, in the order Febris, is the plan which ought to be followed in the order before us. Thus the fever accompanying plague is evidently typhus, which, in effect, when accompanied by eruptions of any kind, is evidently a typhoid eruptive fever, and requires the same treatment as typhus. Chicken-pox, and nettle-rash, have a near approach to synocha, and so far possess the same indications; but they are generally slight diseases, and of not more than three days' duration. The rest, for the most part, are of a mixed breed, and have hence a closer resemblance to synochus: they commence with inflammatory affections; but have soon a strong tendency to run into the putrid type. We shall select an example or two from the diseases of this order, either most important or most frequent.

Variola. Small-pox. This is of two varieties, the distinct and the confluent. The general nature, symptoms and treatment of the former, are so well known, that it is unnecessary to repeat them. In the confluent kind, our chief attention must be directed to support the strength of the system, and to obviate the tendency to great depression of strength and putrefaction of the fluids, which will be effected by the exhibition of cordials, wine, bark, mineral acids, and a nourishing diet, and by all the means recommended in the treatment of typhus, except the application of cold water after the appearance of the eruption; the bowels should be kept regular by the mildest cathartics, or by laxative clysters; some authors, however, recommend a more liberal use of them, unless a diarrhœa has supervened, even when the disease assumes the type of typhus. When the disease is attended with violent symptoms, blisters should be applied in succession, on different parts of the body, without regard to the parts being covered with pustules; if there be obstinate vomiting, the saline draughts should be given in a state of effervescence; or camphor, combined with opium, may be employed with advantage; the extract of cascarilla, administered in some aromatic liquid, is often of use in allaying the vomiting; and if we do not succeed by those means, it will be proper to apply a blister to the region of the stomach: should the epileptic fits continue violent, it will be necessary to administer opiates, both by the mouth and by clysters, which act, not only by their antispasmodic power, but also by perspiration, and mustard cataplasms should be applied to the feet; at the same time gentle cathartics will be necessary, as the recurrence of the fits frequently proceeds from the irritation of retained fæces, especially in children: when a retrocession of the eruption happens, wine, opium, volatile alkali, musk, and camphor, with the warm bath, are the remedies most generally employed; blisters and mustard cataplasms should also be applied to the lower extremities: if the swelling of the face subsides suddenly, and is not succeeded by the swelling of the hands, blisters are recommended to be applied to the wrists and fore-arms; anointing great part of the body with mercurial ointment, or applying a large mercurial plaster to the scrobiculus cordis, under the same circumstances, is often attended with good effects; if the salivation suddenly cease, without any swelling of the hands, blisters should be applied to the wrists, and small doses of ipecacuanha should be administered: should there be a suppression of urine, the patient should be exposed to a current of cool air; if this does not succeed, and he is not in a very debilitated state, and the heat of the body is steadily above the natural degree, it will be proper to dash cold water upon the legs; and perhaps to extend the affusion over the whole surface.

Rubeola. Measles. This disease will be distinguished from the other exanthemata, by the dry, hard cough, hoarseness, sneezing, watering of the eyes, coryza, dyspnœa, and great drowsiness, or coma. From catarrh, the greater violence of the febrile symptoms, the greater affection of the eyes, and many of the symptoms accompanying the eruptive fever of measles, particularly the coma, will afford a ready diagnosis between the two diseases.

The *remedies* indicated in the cure of this disease are, such as will obviate or remove the morbid excitement; blood-letting will therefore be requisite in proportion to the violence of the fever, cough, and dyspnœa, if the nature of the prevailing epidemic does not contra-indicate; but as the danger at the commencement of the complaint is for the most part inconsiderable, that powerful remedy may, unless the excitement is very great, and threatens immediate danger, or much subsequent debility, generally be reserved till after the period of desquamation, which is often succeeded by a more dangerous train of symptoms than any that have preceded; gentle cathartics are indispensably requisite in all cases, such as phosphate of soda, Epsom salts, infusion of senna, &c.; analogy is, however, greatly in favour of calomel; tepid mucilaginous diluents should be freely allowed; it will be advisable to excite a gentle diaphoresis by means of the saline draughts, with small doses of tartarised antimony; the cough will be alleviated, and expectoration promoted, by a solution of spermaceti, gum arabic, or of the pulvis tragacanthæ compositus, or the decoctum hordei compositum may be employed in considerable quantities; inhaling the vapour of hot water, the application of oil round the chest, and the pediluvium, or warm bath, will be found useful auxiliaries; should the cough and dyspnœa prove urgent, attended with pyrexia, or should they remain after the desquamation, blood-letting, either general or local, should be employed: we must, however, be cautious in reducing the strength of the patient; small blisters should be applied in succession about the thorax; the apartment in which the patient continues should be kept cool; he must not be exposed to cool air so freely as in the small-pox, as much disorder may be produced in the system, if, from such exposure, retrocession of the eruption should take place; the degree of temperature should therefore in a great measure be regulated by the patient's feelings: when the excitement is subdued by evacuations, and the cough remains the only troublesome symptom, opiates may then be given with great advantage; and at this period of the disease, a change of air will be of the most essential service. As a morbid tendency remains for some time after this complaint, it will be not only advisable, but indispensably necessary, to administer gentle cathartics at proper intervals. If symptoms of pneumonia should supervene after the desquamation, blood-letting, both general and local, if the strength of the patient will admit of it, blisters, and the other remedies which are mentioned when treating of that inflammation, must be diligently employed: when a diarrhœa remains troublesome, after the desquamation has taken place, it must not be checked too hastily by the employment of astringents and opiates, on account of the tendency to inflammatory complaints which remains after the measles: the cascarilla or columbo may, however, be employed in small doses, before we have recourse to more powerful astringents; blood-letting will generally remove both the diarrhœa and cough; it will, therefore, be advisable to endavour to check the diarrhœa by that evacuation, rather than employ astringents in the first instance. The putrid measles appeared in London in 1672, 1763, and 1768, and have appeared occasionally since: in this variety all the symptoms are more violent, accompanied with greater depression of strength; the remedies must be of the same kind, but more actively and instantaneously employed.

Scarlatina. The general nature and treatment of this disease will be found in *Typhus*, and *Cynanche Maligna*.

Erysipelas. St. Anthony's Fire. This will be readily distinguished from the scarlatina cynanchica, by the absence of the pain, redness, tumour, and sloughs in the fauces and tonsils, and by the other concomitant symptoms. The danger will be in proportion to the violence of the symptoms denoting a tendency to an affection of the brain; the parts which were red becoming suddenly pale, and a considerable degree of coma or delirium, particularly at the commencement of the disease, with an increase rather than diminution of it, after the appearance of the eruption, are symptoms of the utmost danger. When the disease terminates in a favourable manner, there is sometimes a gentle diaphoresis; more frequently, however, the disease goes off without any evident crisis.

In the *removal* of this disease, if there be a considerable degree of excitement, attended with much coma or delirium, and a strong, full, and hard pulse, blood-letting will be necessary, and it should be repeated according to the urgency of the symptoms, strength of the patient, and state of the pulse; an emetic should be given at the commencement of the fever, unless the head is affected, in which case it is at least a doubtful remedy; cooling purgatives are particularly useful; mild diaphoretics, assisted by the plentiful use of mucilaginous acidulated diluents, will be proper; the antiphlogistic regimen must be strictly adhered to, and the patient should be placed in as erect a posture as he can bear without inconvenience; if the delirium, but more particularly the coma, be urgent, blisters should be applied to the shaved head, or between the shoulders; cupping should be advised, and mustard cataplasms should be put upon the soles of the feet. The erysipelatous eruption sometimes shews itself in typhus, and increases the fever, in which case we must have immediate recourse to bark, wine, cordials, the sulphuric acid, and the other remedies for that disease. When the eruption returns periodically, issues and a low diet will frequently prevent it.

Order IV. *Hæmorrhagiæ*; or Sanguineous Fluxes.

These are thus ordinarily defined; pyrexy, with a flow of blood without external violence; the blood, upon venesection, exhibiting the same appearance as in *phlegmasiæ*. The *genera* are: 1. Epistaxis; bleeding from the nose. 2. Hæmoptysis; spitting of blood. 3. Hæmorrhois; piles. 4. Menorrhagia; immoderate menstruation. These, for the most part, and when the profusions are not merely symptomatic or critical, are a natural class of diseases; and, excepting in one or two instances, are to be attacked by a general plan of a similar kind and tendency. They are preceded, for a longer or shorter time, by a sense of fulness and tension in the parts whence the blood is about to issue: if those parts be visible, there is redness, tumour, a sense of heat or itching, and of pain and weight; internally, in the neighbourhood, there is a similar sense, weight, fulness, tension, heat, and pain; and when these symptoms have subsisted for some time, a cold fit comes on, attended with weariness of the limbs, pains of the back and head, costiveness, and other febrile symptoms, succeeded by a hot fit, in the course of which the blood most commonly flows in a greater or less quantity, and after an uncertain time it ceases spontaneously; during the hot stage, the pulse is frequent and full, and in many cases hard, but as the blood flows, the pulse becomes softer and less frequent, and the blood, when drawn from a vein, appears as in the cases of the phlegmasiæ. After an hæmorrhage has once occurred, it frequently observes periodical returns.

The remote *causes* are, a plethoric and sanguine temperament; the suppression or diminution of accustomed evacuations; changeable weather, as spring and autumn; considerable and sudden diminution in the weight of the atmosphere; external heat; violent exercise of particular parts of the body; whatever increases the force of the circulation, as violent exercise, violent efforts, anger, and other violent active passions; postures of the body increasing determinations to, or ligatures occasioning accumulations in particular parts of the body; a determination to certain vessels rendered habitual from the frequent repetition of hæmorrhage; mal-conformation of particular parts; and lastly, cold externally applied, as changing the distribution of the blood, and determining it in greater quantities into the internal parts; or, perhaps, by its exciting some degree of synocha. The proximate cause is supposed to be congestion in particular parts of the sanguiferous system, occasioning distention of these vessels, and violent reaction, the consequence of which is a rupture of them.

Treatment. When an hæmorrhage has taken place, and threatens to go to excess, we must endeavour to moderate or check the flow of blood, and prevent its return; the first indication will be answered by a strict adherence to the antiphlogistic regimen, therefore the removal of every cause of irritation is always necessary, the patient must be kept quiet and still, heat must be particularly guarded against, he should be freely exposed to the cold air, and should be allowed cold or iced water, or iced lemonade, to drink; every exertion of mind or body is to be avoided; a vegetable diet will be most proper, unless the strength of the patient is greatly exhausted, in which case, mild broths, and the mildest kind of animal food, may be allowed: gentle cathartics, or laxative clysters, will be necessary to prevent any accumulation of the fæces, and blood-letting will be requisite, if there is a considerable degree of excitement; dry-cupping is frequently useful, and blisters may be employed with advantage: vomiting is a powerful remedy in diminishing the action of the heart and arteries; the digitalis, however, in our opinion, is a preferable remedy; refrigerants should be ordered, as the sulphuric acid, nitre, cream of tartar, and the vegetable acids; the first of which is, however, the most efficacious medicine. Internal and external astringents must also be employed; of the former class are the vitriolic acid, alum, and the sugar of lead, which is by far the most powerful remedy, and may occasionally be exhibited with advantage in small doses, but the long continued use of this remedy is often attended with dangerous consequences, and it should be given in combination with the opium pill, or some tenacious extract, in order to obviate its pernicious effects on the stomach and bowels. The external astringents in most general use, are, cold applied suddenly, cold water in which salt has been recently dissolved, or powdered ice, or solutions of sugar of lead, alum, or white vitriol, &c.; pressure is a powerful means of checking hemorrhage, when it can be applied to the part; when the hæmorrhage is very profuse, it is improper to employ any means to prevent syncope, unless it partakes very much of the passive state, in which case it must be prevented by every possible means; the cinchona, with chalybeates, are indicated under the same circumstances. When the phlogistic diathesis is taken off, either by the continuance of the hæmorrhage, or by proper remedies, opiates may be given with advantage, and should subsultus tendinum or convulsions supervene, they are particularly serviceable, combined with the camphor, castor, and musk. The return of the hæmorrhage is to be prevented by our counteracting or preventing a plethoric state of the system, by an abstemious diet, or by taking food of a less nutritious quality, by exercise, gestation will be generally more safe, than walking, by gentle cathartics, by cold bathing, bitters, and aromatics, which tend to prevent plethora, by increasing the tone of the vessels, and by studiously avoiding the remote causes; tonics, which must increase the force of the circulation, although indicated, are doubtful remedies, in particular bark and chalybeates; astringents are in general more efficacious, particularly the sulphuric acid, alum, &c. If the plethoric state, notwithstanding our endeavours, should become considerable, and a return of the hæmorrhage is threatened, blood-letting, both general and local, and blisters, will be proper, when the vis a tergo is great, but when the habit is debilitated, it will be more advisable to employ only local blood-letting and blisters; it will be proper to remark, that blood-letting should always precede the employment of blisters.

These directions will suffice for the treatment of hæmorrhagies in general. Upon menorrhagia we shall enter more fully in the article **Midwifery**, and shall only in the present place offer a few words on phthisis.

Phthisis; or Pulmonary Consumption: upon the Cullenian system is made a species of hæmoptysis. The impropriety of thus naming a disease from a single, and that only an occasional symptom, must be obvious to every one. But our only duty at present is to describe the disease. This then is generally preceded by more or less of the following symptoms: a slight degree of fever, increased by the least exercise; a dry burning heat of the palms of the hands, particularly towards evening, and of the soles of the feet towards morning; moisture of the eyes after sleep; irregular flushings; hoarseness; a dry, troublesome, and sonorous cough, occasioning slight pain or stiches, most commonly in the sides; some degree of hardness of the pulse; lancinating or fixed pains in the thorax; head-ach; frequent fainting fits; some degree of dyspnœa, increased on using exercise; an expectoration of a small quantity of thin, frothy matter; impaired appetite; restless nights, and universal disinclination to motion or exercise; this may be termed the inflammatory or first period. In a short time the fever becomes more severe, with accessions in the afternoon or evening, and some remission in the morning; the pulse, however, is even then quicker than natural: the cough is increased by a recumbent posture, and prevents sleep till towards morning, when a slight moisture appears upon the breast and upper parts of the body; the expectoration increases in quantity, is frothy, and sometimes streaked with blood; the face is commonly pale, but during the fever the cheeks appear as if painted with an almost circumscribed spot of pure florid red; the feverish heat is augmented after eating, particularly solids, and on taking exercise; the burning heat in the palms of the hands and soles of the feet becomes more perceptible; there is difficulty of lying on one more than the other side, wandering or fixed pains are felt in some part of the thorax, and the disease is accompanied with lassitude and asperity of the temper: the appetite becomes somewhat impaired, and there is frequently vomiting after eating. As the disease advances, the hectic fever is established, and the remissions become more distinct, attended with colliquative morning sweats; an exacerbation occurs about noon, and a slight remission happens about five in the afternoon: this is soon succeeded by another exacerbation, which gradually increases until after midnight, but after two o'clock in the morning, a second remission takes place, and is attended with more or less, sometimes profuse, sweating, which greatly debilitates the body; sometimes, however, the second exacerbation in the evening is not observed, but the exacerbation which took place about the middle of the day increases till evening, continues violent until the morning sweat breaks out, when the patient gets some unrefreshing sleep; the exacerbations are frequently attended with some degree of cold shivering, or more frequently only a sense of chilliness, or increased sensibility to cold, is perceived; when to the thermometer the skin is preternaturally warm: the expectoration now becomes more viscid, copious, yellow, greenish, streaked with blood, disagreeable to the taste, and is discharged in small spherical masses, resembling pus, and is frequently also of an ash-colour: the cough abates in violence, but not in frequency, and is more distressing in the first part of the night, the breathing is short and quick, and the breath has an offensive smell; the pulse is frequent, full, and tense, or small and quick; the countenance now gives evident signs of wasting, the eyes lose their lustre and brilliancy, sink, grow dull and languid; the cheeks appear prominent, the nose sharp, the temples depressed, and the strength rapidly declines; this may be esteemed the second period: from the beginning the appetite is less affected than could be expected, the body is for the most part costive, particularly after the morning sweats have begun to take place: the urine is generally high-coloured, and deposits a curdly pink sediment; about this period, in females, sometimes sooner, the menstrual discharge ceases, in consequence of the increasing debility. The third stage commences with a slight purging, which soon becomes a colliquative diarrhœa; when this takes place the fever, heat, and morning sweats abate; but the cough continues distressing through the night; the tunica adnata becomes of a pearly white, the tongue appears clean, and with the fauces is of a bright red colour, sometimes covered with aphthæ, and generally sore and tender; the voice grows hoarse, and there is shortness of breath and hiccup, both of which distress the patient greatly; the lower extremities swell, and retain the impression of the finger. At this stage of the disease, sometimes sooner, the appetite is observed to become unnaturally keen, which deludes the unhappy sufferer and friends: as the disease advances, the diarrhœa becomes more violent, and sometimes alternates with the sweats, the strength rapidly decays, and memory and their affections forsake them; as the fatal period approaches, they have frequent and long faintings, the hairs fall off, the nails are incurvated; sometimes there are slight convulsions, and a few days before death delirium comes on, and continues till that event takes place, or the senses remain entire, and the mind remains still confident and full of hope, till death steps in, and gently puts an end to their hopes and sufferings. As it is a matter of consequence to distinguish pus from mucus, we shall subjoin the following ingenious experiments of the late Mr. Charles Darwin:

1. Pus and mucus are both soluble in the sulphuric acid, though in very different proportions, pus being much the less soluble. 2. The addition of water to either of these compounds decomposes it; the mucus, thus separated, either swims on the mixture, or forms large flocci in it; whereas the pus falls to the bottom, and forms, on agitation, an uniform turbid mixture. 3. Pus is diffusible through a diluted sulphuric acid, though mucus is not; the same occurs with water, or a solution of the muriate of soda. 4. Nitrous acid dissolves both pus and mucus; water, added to the solution of pus, produces a precipitate, and the fluid above becomes clear and green, while water and the solution of mucus form a dirty-coloured fluid. 5. Alkaline lixivium dissolves (though sometimes with difficulty) mucus, and generally pus. 6. Water precipitates pus from such a solution, but does not mucus. 7. Where alkaline lixi-

vium does not dissolve pus, it still distinguishes it from mucus, as it then prevents its diffusion through water. 8. Coagulable lymph is neither soluble in diluted nor concentrated sulphuric acid. 9. Water produces no change on a solution of serum in alkaline lixivium, until after long standing, and then only a very slight sediment appears. 10. The muriate of mercury coagulates mucus, but does not pus. From the above experiments, it appears that strong sulphuric acid and water, diluted sulphuric acid, and caustic alkaline lixivium and water, will serve to distinguish pus from mucus; that the sulphuric acid can separate it from coagulable lymph, and alkaline lixivium from serum; and hence, when a person has any expectorated material, the composition of which he wishes to ascertain, let him dissolve it in sulphuric acid, and in caustic alkaline lixivium, and then add pure water to both solutions; and if there be a fair precipitation in each, he may be assured that some pus is present: if in neither a precipitation occur, it is certain that the material is entirely mucus: if the material cannot be made to dissolve in alkaline lixivium, by time and trituration, we have also reason to believe that it is pus. To the above ingenious experiments may be further added, the coagulation of pus by the muriate of ammonia, as observed by Mr. Home, and its globular appearance through the microscope; pus is also of the consistence of cream, of a whitish colour, and has a mawkish taste; it is inodorous when cold, and when warm it has a peculiar smell.

The predisposing *causes* are, hereditary disposition; mal-conformation of the chest; sanguine temperament; scrofulus diathesis; which is indicated by a fine, clear, and smooth skin, large veins, delicate complexion, high coloured lips, the upper one swollen, white and transparent teeth, light hair, and light blue eyes, with a dilated pupil: there is great sensibility, uncommon acuteness of the understanding, and a peculiar gentleness and softness in their manner; the immoderate use of venery; certain diseases, as the hooping-cough, syphilis, and various exanthemata, particularly the measles; various employments, as stone-cutters, needle-grinders, flax-dressers, and all sedentary occupations, particularly those which require a considerable degree of stooping; the retrocession of eruptions; indulgence in intoxicating liquors; and according to Dr. Beddoes, hyper-oxygenation of the blood. The exciting causes are, hæmoptysis; empyema; catarrh, particularly the influenza; asthma, obstructions of the abdominal viscera, particularly an enlarged and indurated state of the liver; calculi formed in the lungs; contagion and tubercles. The proximate cause is supposed to be an ulcer in the lungs.

The *prognosis* in this disease depends upon the causes whence it originates, and upon the violence of the symptoms; if it be in consequence of empyema or tubercles, there is more danger than when it arises from hæmoptysis or wounds in the chest, but every case of phthisis is always attended with danger. The progress of phthisis is often interrupted by pregnancy and mania; the latter has produced a radical cure, but in the former it almost always returns after delivery with increased violence.

In the *treatment* of this disease it will be particularly expedient to avoid, and, if in our power, to remove the occasional causes mentioned above, by the proper methods, which are mentioned in other parts of this treatise; if several of the premonitory symptoms, as a dry, short, troublesome cough, occasional stitches in the side, slight dyspnœa upon using exercise, and a pulse somewhat accelerated and hard, should attack a person of a phthisical habit, the most powerful remedies must be employed without loss of time: blood-letting, in a moderate quantity, will be necessary, and it should be repeated at proper intervals till those symptoms are relieved, taking care, however, not to reduce the strength of the patient too much, as debility is the most urgent symptom in the course of the disease: the bowels should be kept regular by gentle cathartics, as the calomel and rhubarb. After these evacuations, the ipecacuanha, either alone, or with a small quantity of emetic tartar, should be given in the morning, fasting, in such doses as will excite vomiting once or twice at most; when the heat, fever, cough, and pain in the chest are considerable, small doses of the nitre, or the saline mixture, with nauseating doses of the emetic tartar, should be given three or four times in the course of the day: in this stage of the disease, small doses of colomel, administered at bed-time, are of considerable service, except there is a tendency to diarrhœa, as the bowels, by its use, are not only kept regular, but it, at the same time, acts as a powerful deobstruent, and, in our opinion, an alterative course of mercury is of advantage, in the incipient stage of phthisis, for the removal of indolent tubercles: should the cough prove violent, opiates may be given at bed-time, and in the night, if necessary, the extractum papaveris albi, in doses of five grains or more, is particularly suitable; if there be a fixed pain in the breast or sides, increased upon coughing, local blood-letting, and small blisters applied in succession about the thorax, will afford considerable relief, or a seton may be made as near the part affected as possible. In the second stage of the disease, the employment of emetics, composed of the ipecacuanha, with a few grains of the sulphate of zinc, must be duly persisted in, in the morning, fasting: when the morning sweats are very profuse, the infusion of roses or vitriolic acid should be employed with freedom; æther in the proportion of two or three drachms to a pint of water, with some of the mucilage of quince-seeds, makes a grateful and slightly tonic mixture, a glassful of which may be taken frequently, or the Bristol or Seltzer waters may be drank; they are very efficacious in moderating the thirst, burning heat of the palms of the hands and soles of the feet, and the partial night sweats: opiates must be given in such doses as will quiet the cough and procure sleep, taking care, however, to obviate costiveness, and if the patient feel a sickness in the morning after them, coffee will effectually remove it; mucilaginous fluids, combined with small quantities of spermaceti, are also of service in allaying the irritation in the fauces. When the inflammatory diathesis is subdued, chalybeates, combined with myrrh and carbonate of potash, may be given with advantage; lime-water is a suitable menstruum for dissolving the myrrh. The digitalis is strongly recommended in these two stages in particular; it certainly is deserving of a fair and impartial trial, and appears to be a medicine well suited to this disease, more especially in the inflammatory stage, from its well known power of rendering the action of the heart and arteries more slow than natural, a desideratum in phthisis, in which the pulse ranges from eighty to one hundred and twenty, or more; it also is very efficacious in exciting the action of the absorbents: the factitious airs may also prove an useful auxiliary, or air impregnated with the oxide of zinc, or manganese, in their most comminuted state, might be applied to the lungs by means of an apparatus, as recommended by Dr. Darwin, in his Zoonomia, or by that of Mr. Watt, of Birmingham: the vapour of a saturated tincture of æther, impregnated with hemlock, may be inhaled; it is made by macerating for a few days from one to two scruples of the dried leaves of the hemlock in an ounce of the æther. The hectic paroxysm may be prevented, or cut short, by the effusion of tepid water at the commencement of the hot stage, or its effects may always be moderated by moistening the palms of the hands and soles of the feet with vinegar or cold water; it should always be resorted to, when the burning heat mentioned above is present; it is not only perfectly safe, but highly refreshing. In the third stage, should the above plan not be adopted in time, and diarrhœa has made its appearance, the gentle emetics before mentioned are recommended to be administered, provided the strength of the patient is not too much exhausted; mild astringents should at the same time be employed, as the decoction of hartshorn, or logwood, angustura, colombo, kino, and mucilaginous demulcent liquors, combined with opiates and absorbents. During the inflammatory period of phthisis, a vegetable diet, with milk, is indispensably requisite; souins, sago, barley, and rice, afford an agreeable variety; the lichen islandicus is strongly recommended, and is deserving of a trial; the ripe subacid fruits may be indulged in at pleasure; attention must, however, be paid to the state of the bowels: oysters, muscles, craw-fish, lobsters, and the testacea in general, also flounders and whitings, may be allowed occasionally, provided they do not disagree with the stomach, and do not aggravate the symptoms. In the advanced periods, when the hectic is completely formed, a small portion of animal food may be taken for an early dinner, if it does not greatly increase the heat, and when the appetite becomes voracious, which it sometimes does towards the fatal termination, small quantities should be taken frequently: the drink, in almost every period of the disease, should consist of toast and water, Malvern water, milk and water, buttermilk, rice water, or the juice of ripe subacid fruits mixed with water, and occasionally lemonade. Wine, spirits, and fermented liquors of all kinds, must be strictly prohibited, and the practice of mixing rum and other spirits with milk cannot be too strongly reprobated; where, however, there is but little increased excitement, and the pain is inconsiderable, a more nourishing diet, and a moderate quantity of wine, may be allowed, but the wine should be more or less diluted with water, and in the purulent stage, an invigorating diet always affords more or less relief. During the whole course of the disease, every irregularity and all crowded places must be studiously avoided. The patient should be advised to repair to Bristol in the early part of the disease, and should make use of such exercise, as his strength will bear, as swinging, gestation in a carriage, or riding on horse-back in progressive journeys, or the alternation of this last exercise, and gestation in a carriage, but a sea voyage is the most effectual of all kinds of gestation; the patient must by all means avoid the piercing north-east winds in this country; it will therefore be advisable for him to visit a temperate southern climate during the winter and spring: the patient should be advised to lie on a hair mattress, with slight coverings over his body, and should be earnestly requested to go to bed early, and to get up soon in the morning, even if obliged, through debility, to lie down in the course of the day: the feet should be kept dry and warm, and the patient should wear flannel or cotton next to his skin; the former, however, is far more salutary; in the florid consumption, an elevated and inland air is often of the most essential service. Should we be so fortunate as to subdue this too fatal disease by the means recommended above, it will be indispensably requisite for the patient to persevere in employing the regimen recommended in the treatment of this complaint, for a considerable length of time after every symptom of the disease has disappeared, and he must return to his former manner of living with the utmost caution; the diet should, however, be light and nourishing, and in moderate quantity: the patient should breathe a pure dry air, and should take such exercise, particularly on horse-back, as he can bear without fatigue, and should use the warm bath; and when the constitution can be brought to bear it, he may employ the cold bath or sea bathing.

Order. V. *Profluvia.* Insanguineous Fluxes.

These are ordinarily characterised, as consisting of pyrexy with an increased secretion, naturally void of blood. The genera are two: 1. Catarrhus, Catarrh. 2. Dysenteria, Dysentery. This order might easily be suppressed, and the genera it comprises transferred to other situations, to which they more properly belong, even under the present nosology. Catarrh is described as possessing pyrexy, frequently contagious; an increased secretion of mucus, or at least efforts to excrete it. Dysentery, as evincing contagious pyrexy, frequent mucous or bloody stools, while the alvine fæces are for the most part retained, gripes, tenesmus.

Catarrh will be distinguished from the measles by the greater mildness of the febrile symptoms, by the state of the eyes, by the absence of coma, and many of the symptoms accompanying the eruptive fever of measles.

The disease is rarely attended with danger, except there be great difficulty of breathing, attended with a livid and bloated countenance, or it has been treated with negligence or impropriety, in which case it often passes into pneumonic inflammation, attended with symptoms of the utmost danger; in general, however, it is a slight and safe disease, unless it attack persons of a phthisical habit, or those advanced in life; in the former it may occasion phthisis, and in the latter peripneumonia notha.

For its *cure*, nothing more is requisite, in general, than abstinence from animal food for a few days, keeping the body warm, and drinking freely of tepid mucilaginous diluents; if there be, however, a considerable degree of excitement, blood-letting will be necessary, but it must be employed with some degree of caution, as it is frequently succeeded by depression of strength, particularly when catarrh is epidemic. If there be much oppression and tightness about the chest, occasioning a degree of dyspnœa, local blood-letting will be advisable, and blisters must be applied to the sternum and scrobiculus cordis; gentle laxatives should be ordered: the patient should take copious draughts of some mucilaginous acidulated liquids; a gentle diaphoresis should be promoted by nauseating doses of tartar emetic, with spirit of mindererus, or by exhibiting the volatile alkali in wine whey; the vapour of warm water, impregnated with vinegar, should be frequently inhaled; mucilaginous oily demulcents should be given, and expectoration should be promoted by the means pointed out when treating of pneumonic inflammation. If the cough remain troublesome, after we have subdued the inflammatory diathesis, opiates, combined with the tartar emetic, or with ipecacuanha, may be employed with safety and advantage; rubbing the nose externally with oil, some ointment, or with what is most commonly employed, warm tallow, is very often of great service, when the mucus membrane of the nose is much affected, which practice has very frequently come under my observation. In the treatment of the epidemic catarrh (influenza), as being frequently attended with a considerable degree of debility, the antiphlogistic regimen must not be pushed too far, even though there may be some appearance of excitement: it will, in general, if blood-letting should be deemed necessary, be more advisable rather to trust to local than to general blood-letting, blisters, mild diaphoretics, and diluents; sometimes, however, a more liberal diet, and the moderate use of wine, will answer better. Might not the affusion of tepid, or even cold water, be employed with safety, if the heat of the surface be greater than natural, and there be at the same time no tendency to asthma or phthisis pulmonalis?

Dysentery is most commonly preceded by costiveness, unusual flatulence, acid eructations, and wandering pains in the bowels; in most cases, however, from the commencement, griping pains are felt in the lower part of the abdomen, which often arise to a considerable degree of severity; the bowels are irritated to frequent evacuation, in indulging which, but little is voided, and the rectum often becomes exquisitely painful and tender; the matter evacuated is often very fœtid, and the stools are frequently composed of mucus, pus, blood, membranous films, and white lumps of a sabaceous nature, the mucus is generally mixed with a watery fluid, and is often frothy: tenesmus, in a greater or less degree, generally accompanies the evacuation of the bowels, and it very rarely happens that the natural fæces appear during the whole course of the disease, and when they do, they are in the form of scybalæ, that is, small separate balls, which appear to have lain long in the cells of the colon; when these are voided, either by the efforts of nature, or as solicited by medicine, they procure a remission of all the symptoms, more especially of the frequent stools, griping and tenesmus; with these symptoms there is loss of appetite, great anxiety about the præcordia, frequent sickness, nausea, vomiting, and the matter ejected is frequently bilious, watchfulness and prostration of strength: there is always some degree of symptomatic fever, which is sometimes of the remittent or intermittent type; sometimes it assumes the synochous, and very frequently the typhous type: the tongue is white, and covered with tough mucus, or rough, dry, and sometimes black; the patient complains of a bitter taste in the mouth, and in the advanced stage of the disease there is hiccup, and aphthæ. If the small intestines only be affected, the pain is described to be most acute and excruciating about the umbilicus, the bowels are not evacuated immediately after the griping pains, the blood is mixed intimately with the fæces, and the sickness, vomiting, and pain at the stomach, are more urgent. If the large intestines be the seat of the disease, the pain is more obtuse, not so constant, is more distant from the umbilicus, and is more immediately followed by stools, and the purulent matter of blood, if their be any, is less mixed with the rest of the excrements or only floats upon them, and there is more sickness than griping; but it frequently happens, that both the large and small intestines are affected, which renders it very difficult to determine, with any certainty, the seat of the disease. The remote causes, are, cold alternating with heat, derangement of the primæ viæ, and contagion. The proximate cause is supposed to be a preternatural constriction of the intestines, more particularly of the colon. This disease will be readily distinguished from diarrhœa, by the absence, or less degree of fever in the latter; the less degree of griping and tenesmus, the appearance of the stools, and the other symptoms in diarrhœa, will further assist us.

Treatment. When the patient is of a robust and plethoric habit, and the disease is attended with acute pain in the bowels, with a strong full pulse, blood-letting will be necessary, but it must be practised with caution, especially in warm climates, where the employment of powerful antiphlogistic measures is often succeeded by a sudden and dangerous degree of debility; gentle emetics should be administered; they are not only useful in emptying the primæ viæ, but they also determine to the skin; they will be more efficacious when given in such small and repeated doses as not to excite immediate vomiting, unless the oppression at the stomach is urgent; the emetics generally employed in dysentery are ipecacuanha and tartar emetic, and, at the early periods of the disease, they will be more efficacious when combined: the morbid and noxious contents of the intestines, the most pernicious source of irritation in dysentery, must be expelled by cathartics; those most generally celebrated are, the ipecacuanha and tartar emetic, the former is, however, most frequently employed; it may be given either alone, or in combination with the crystals of tartar, in such doses as will produce some degree of nausea, and repeated when the nausea abates; the calomel is an excellent remedy where there is a tendency to inflammation, but it should never be given alone; its operation is rendered both more easy and certain, by combining it with other cathartics; the most effectual remedy, however, in general, is a simple solution of Epsom salts, or Glauber's, or it may be given in a diluted infusion of senna, with a considerable proportion of manna; the cream of tartar with tamarinds, the phosphate of soda, and castor oil, will make an useful variety; after the operation of the cathartic is finished, it will be advisable to administer opiates, and they will be more efficacious if given with nauseating doses of emetics; the pulvis ipecacuanhæ compositus is a good medicine; the hyoscyamus, by its anodyne and gently laxative qualities, seems eminently adapted to this disease. The warm bath is often used with advantage; fomentation of the abdomen is more frequently serviceable, but the most effectual remedy is a large blister applied over the abdomen; in mild cases, however, so severe a remedy is not necessary; the addition of strong peppers to the fomentations may, in such cases, answer our intentions; the pain attending the tenesmus will be allayed by fomenting the anus with hot water, or with the decoction of chamomile flowers, with some tinctura opii sprinkled on the stupes: strangury is not an uncommon symptom: independent of cantharides, it will be effectually relieved by fomenting the pubes and perinæum: mucilaginous demulcent liquids must be given freely, for the purpose of defending the intestines against the acrimony of their contents, and mucilaginous and oily clysters should be employed once or twice a day, or more; they are very serviceable for the same intention as the mucilaginous liquids, and act also as a fomentation; they should consist of a strong decoction of linseed or starch, or they may be composed of milk and oil, united by means of mucilage. In the advanced and chronic stage of the disease, as acidity of the stomach chiefly prevails at that period, absorbents will be useful, as the mistura cretacea, aqua calcis, pulvis cretæ compositus, &c. combined with opiates; astringments will also, at this period of the disease, be proper, as the kino, hæmatoxylum, catechu, &c. and if the powers of the stomach be much weakened, they may be combined with chalybeates. The tone of the bowels will be restored by administering quassia, bark, angustura, or columbo; an infusion of gentian and cinnamon in port wine is recommended: it will always be advisable to join aromatics with bitters: a purgative of the calomel and rhubarb should be given from time to time in this form of the disease, and when it remains obstinate, we may always suspect visceral obstruction; should this, upon examination, be the case, mercury, either internally, or by friction, should be employed, until some sensible effect is produced in the mouth. The diet in the first stage should consist of milk, sago, panada, salep, Indian arrow-root (maranta arundinacea), and rice, the quantity being regulated by the appetite; the sweet and subacid fruits may be allowed, and they are particularly serviceable when there is much bile in the primæ viæ. In the more advanced stages, the ripe fruits are condemned, but it does not, however, appear, on sufficient grounds, that they should be so; together with the farinacea, a small quantity of animal food may be allowed in the chronic state of the disease, provided it does not disagree with the patient. The drink at the commencement should be either barley or rice water, boiling water poured upon toasted bread, or burnt biscuit, whey, or the decoction of hartshorn, and the like; in the advanced stage of the disease, port wine or Madeira, or a moderate quantity of spirits diluted with water, will be proper; the patient should wear flannel next to the skin for some time after the disease is gone off, and should take as much exercise as he can bear without fatigue, either on horse-back or in a carriage, carefully avoiding exposure to cold or moisture. The powder or extract of nux vomica is strongly recommended by Dr. Hufeland, in doses of from six to ten grains of the powder, three times a day; or one or two grains of the extract may be given every two or three hours; three or four grains or more may be given in clysters: children of one year old may take from one to two grains of the extract in the twenty-four hours; it is necessary to observe, that the medicine is directed to be administered in some mucilaginous mixture. It is of consequence to warn the young practitioner, in the most forcible manner, against employing opiates at the beginning of this disease, unless a free evacuation of the bowels has been procured by cathartics, and the excitement much diminished, as they generally aggravate the disease; and it will always be pernicious to give them without nauseating doses of emetics, while the griping pains remain; the hyoscyamus, if anodynes be deemed requisite, is preferable to opium, in consequence of its possessing a gently laxative quality.

CLASS II. NEUROSES,

This class of diseases is characterised by an injury of the sense and motion, with an idiopathic pyrexy, or some local affection. It comprises the following orders.

ORDER I. *Comata.* STUPORS.

Implying a diminution of voluntary motion, with sleep, or insensibility, and including the following genera: 1. Apoplexia, apoplexy, which is either idiopathic or symptomatic, and is described thus; almost all voluntary motion diminished, with sleep more or less profound; the motion of the heart and arteries remaining. 2. Paralysis, palsy, only some of the voluntary motions diminished, frequently with sleep. These also are either idiopathic or symptomatic; the species are, asthenic, paralytic, convulsive.

Of *apoplexy*, the symptoms are so well known, that they need not be repeated. Dr. Baily remarks very justly, that "when the patient is not cut off at once, but lives for some time after the attack, the hemiplegia, which is almost constantly an effect of this disease, is upon the opposite side of the body from that of the brain in which the effusion of blood has taken place: this, the learned author observes, would seem to shew, that the right side of the body derives its nervous influence from the left side of the brain, and the left side of the body, its nervous influence from the right side of the brain." This disease is observed to make its attacks most frequently about the period of the equinoxes.

The predisposing *causes* are, a declension from the meridian of life, a large head, a short neck, the sanguine or phlegmatic temperament, obesity, an indolent life, or one too much devoted to study, too long sleeping, high living, indulgence in spirituous liquors, the gout, and the suppression or cessation of the hæmorrhoidal, or any other habitual hæmorrhage or evacuation. The exciting causes are, violent exercise, as dancing after too great repletion of the stomach, a full and long continued inspiration, too strong exertions of the mind, every passion which agitates the human frame, great external heat, especially from a crowded room, intemperance, warm bathing, crudities in the primæ viæ, violent emetics, the spring season, rapid alternations of heat and cold, too great indulgence in smoaking tobacco, long stooping with the head down, tight ligatures about the neck, over distention of the blood-vesself of the brain or its membranes, an effusion or extravasation of blood or serum into the substance of the brain or its ventricles, fractures of the scull or depression of it, causing an effusion of blood upon the brain or its meninges, and tumors within the cranium. The proximate cause is supposed to be whatever interrupts the motion of the nervous power, from the brain to the muscles of voluntary motion. Difficulty of swallowing, and the regurgitation of the drink through the nostrils, great difficulty of breathing, and foaming at the mouth, are symptoms of the most imminent danger; but the prognosis may be generally collected from the violence of the attack, profoundness of the sleep, stertorous breathing, and the degree of the affection of the respiration, and of the powers of sense and of motion; the first attack of this disease is not commonly fatal, particularly if the patient be not cut off in the course of the first week; it frequently terminates favourably either by diarrhœa, hæmorrhage, return of the hæmorrhoidal, or any other habitual discharge, and sometimes by the appearance of fever.

Treatment. As this disease arises in consequence of an effusion of blood or serum into the ventricles of the brain, or upon its meninges, blood-letting in a moderate degree may be of service, but copious bleedings must be injurious, by weakening the patient and preventing the absorption of the effused fluid; the blood should be taken from the temporal artery, or the jugular vein, and if that cannot conveniently be done, it may be taken from the arm; if one side be more affected than the other, the blood should be taken from the side least affected; cupping the occiput is often serviceable, and it does not reduce the patient's strength so much as general blood-letting; warm fomentations of the shaved head, continued for a length of time, and frequently repeated, will be of service; an emetic is recommended to be administered, but, in our opinion, it is at least a doubtful remedy, unless the patient is affected with nausea, in consequence of repletion of the stomach; acrid cathartics, as aloes, resin of jalap, calomel combined with the scammony, or with the extract of colocynth, &c. should be given by the mouth, if the power of swallowing remains; and clysters composed of a solution of some of the above cathartics, and the oleum succini, should be injected; blisters should be applied to the head, spine, and extremities, or a large caustic should be applied to the neck, and mustard cataplasms to the feet: the patient should be kept cool, and as much in an erect posture as he can bear without inconvenience; small electric shocks should be sent through the head; errhines and acrid volatile medicines are recommended, but to us they appear at least doubtful remedies: if the disease appear to be the consequence of the suppression of the hæmorrhoids, leeches should be applied to the hæmorrhoidal veins, fomentations must be employed, and the intestines must be stimulated by means of aloetic cathartics. The strength of the system will be restored by bark, bitters, and chalybeates. The return of this disease is to be prevented, by studiously avoiding all the remote causes which are in our power; a plethoric state of the blood-vessels of the brain must be obviated by a low diet, abstinence from fermented or spirituous liquors, moderate exercise, as riding on horse-back, if not affected with frequent fits of giddiness, or by walking; costiveness must be prevented by gentle cathartics; and if the disease had arisen from the suppression of the hæmorrhoidal flux, aloetic purgatives will be most suitable; an issue or seton should be made as near as possible to the head, or, as being less disagreeable, a thin slice of the fresh root of the daphne mezereum, steeped in vinegar for twenty-four hours, may be applied daily, and if the inflammation should be very considerable, and the discharge profuse, it may be left off for a few days, and the parts should be kept moistened with a solution of sugar of lead.

In *palsy* many of the symptoms have a resemblance to those of apoplexy; it will be distinguished from apoplexy, however, by the pulse, which, in this disease, is slow and soft, and by the other symptoms. If it arise from the causes producing apoplexy, it must necessarily be treated in the manner just recommended. When the apoplectic symptoms are removed, and hemiplegia or paralysis only remains, or when it arises from diminished energy of the nervous system, it will be proper to prescribe internal and external stimulants. Of the former class are, white mustard seeds, slightly bruised or swallowed whole, in the quantity of a large table-spoonful, three or four times a day, or horse-raddish scraped, a table-spoonful of which may be swallowed without chewing, night and morning, or they may be combined and made into an infusion, by macerating two ounces of each in a quart of boiling water for four hours, and adding two ounces of the spirit of pimento to the strained liquor, of which two or three ounces may be given three or four times a day; the arnica montana is strongly recommended; the volatile alkali is often of service, and sumach is deserving a trial; from half a grain to three or four grains or more of the dried leaves are directed to be given two or three times a day: of the latter class of stimulants are, blisters, friction of the parts affected with mustard, æther, volatile alkali, linimentum ammoniæ fortius, or the oleum terebinthinæ, combined with the oleum succini and tincture of cantharides; stinging with nettles and electricity; both sparks and shocks will be of considerable service, particularly if employed early in the disease; flannel must be worn next the skin; warm sea-bathing, and friction with flannel or the flesh-brush, will be useful auxiliaries. If the disease appear to have arisen in consequence of intemperance, the liver will most probably be found to be more or less in a diseased state, which will be known by referring to the diagnostic remarks in the article Dietetics, in which case, some of the preparations of mercury may be given with much advantage, employing afterwards bitters, bark, and chalybeates; the diet should be light, nourishing and stimulating. The bath waters are very serviceable, both by the mouth, and as a bath, particularly so if the disease have arisen from intemperance, or the colica pictonum; should there, however, be a constitutional determination to the head, we must strictly attend to the effects which the bath waters produce upon the system, as they may suddenly induce much mischief.

ORDER II. *Adynamiæ*. DEFECTIVE POWERS.

This title is inexplicit, as being equally applicable to a variety of other orders as well as to the present. The order is characterised thus: a diminution of the involuntary motions, whether vital or natural.

The genera are: 1. Syncope, or fainting; a diminution, or, for a short time, a total stoppage, of the motion of the heart. It is either idiopathic, or symptomatic. 2. Dyspepsia, or indigestion; anorexy, nausea, vomiting, inflation, belching, rumination, heart-burn, pain in the stomach; these, or some of these symptoms at least concurring, for the most part, with a constipation of the belly, and without any other disease either of the stomach itself or of any other parts. 3. Hypocondriasis, indigestion with langour, sadness and fear without any adequate causes, in a melancholy temperament. 4. Chlorosis, green sickness, or a desire of something not used as food, a pale or discoloured complexion, the veins not well filled, a soft tumour of the whole body, debility, palpitation, suppression of menstruation.

It is obvious that the genera of this order relate for the most part, either to those which belong naturally to the tribe of diseases of indigestion, and have already been treated by us under the article Dietetics, or else are catenated with peculiar states of the female frame, and as such fall naturally into the article Midwifery, and will be noticed under that term.

Order III. *Spasmi.* Spasms.

Irregular motions of the muscles or muscular fibres. This definition, however, does not sufficiently distinguish this order from some of the species of syncope, which ranges under the last. It is a very numerous family, divided into two sections.

A. In the animal functions: 1. Tetanus, a spastic cramp or rigidity of almost the whole body, varying according to the remote cause, as it arises either from something internal, from cold, or from a wound, or according to the part of the body affected, be the cause what it may. 2. Trismus, a spastic rigidity of the lower jaw; two species, the first seizing infants, the second seizing persons of all ages from a wound or cold. 3. Convulsio, convulsions, commonly so called, an irregular chronic contraction of the muscles without sleep; idiopathic, and symptomatic. 4. Chorea, St. Vitus's dance, attacking those who have not yet arrived at puberty, most commonly within the tenth and fourteenth year of age, with convulsive motions, for the most part in attempting the voluntary motion of the hands and arms, resembling the gesticulations of mountebanks; in walking, appearing to drag rather than to lift one of the feet after the body. 5. Raphania, a spastic contraction of the joints, with a convulsive agitation, and most violent periodical pain. 6. Epilepsia, epilepsy, a convulsion of the muscles with sleep, from various causes, and of various species; cerebral, sympathetic, occasional, as proceeding from injuries of the head, pain, worms, poison; from repulsion of the itch, or an affusion of any other acrid humour, from crudities in the stomach, from passions of the mind, from on immoderate hæmorrhage, or from debility. 7. Palpitatio, palpitation, a violent and irregular motion of the heart. 8. Asthma, a difficulty of breathing, returning by intervals, with a sense of strictness in the breast and a noisy respiration with hissing. In the beginning of the paroxysm no cough, or the coughing difficult, but the cough free towards the close, frequently with a copious spitting of mucus: three species, spontaneous, from eruptive fevers, from plethora. 9. Dyspnœa, impeded respiration, a continual difficulty of breathing, without any sense of straitness, but rather of fulness and infarction in the breast; a frequent cough throughout the whole course of the disease; eight idiopathic species; three symptomatic, accompanying diseases of the heart; a swelling in the abdomen, producing various maladies. 10. Pertussis, hooping cough, a contagious disease; convulsive strangulating cough, reiterated with noisy inspiration; frequent vomiting. 11. Pyrosis, water-brash; a burning pain in the epigastrium, with plenty of aqueous humour, for the most part insipid, but sometimes acrid, belched up. 12. Colica, colic, pain of the belly, especially twisting round the navel, vomiting, constipation. Numerous species, varying according to the nature of the remote cause, and hence proceeding, *a*, from metallic poisons; *b*, from acids taken inwardly; *c*, from cold; *d*, from a contusion of the back; *e*, from costive habit; *f*, from retained meconium. 13. Cholera; Illiac passion; a vomiting of bilious matter, and frequent excretion of it by stool, anxiety, gripes, spasms in the calves of the legs. Two species, the one arising in a warm season without any manifest cause; the other from acrid matters taken inwardly. 14. Diarrhœa, looseness, frequent stools: the disease not infectious; no primary pyrexy. The species are, crapulous, or from excess of eating; bilious; mucous; cœliac, discharging a chyle-like secretion; lienteric, in which the aliments are discharged with little or no change; atrabiliary. Of these several have been already noticed in the article **Dietetics**. 15. Diabetes, a chronical profusion of urine, for the most part preternatural, and in immoderate quantity. Two species, D. mellitus, with urine of the smell, colour, and taste of honey; D. insipidus, limpid, but not sweet urine. 16. Hysteria, hysterics, rumbling of the bowels, a sensation as of a globe turning itself in the belly, ascending to the stomach and fauces, and then threatening suffocation; sleep; convulsions; a large flow of limpid urine; the mind involuntarily mutable and fickle. Almost all the varieties of this disease proceed from irregularity in the female sexual organs, and will be found described under the article **Midwifery**. 17. Hydrophobia, a dislike and horror at any kind of drink, as occasioning a convulsion of the pharynx, induced for the most part by the bite of a mad animal. The species are, rabid hydrophobia, from the bite of a mad animal, the desire to bite being propagated; and simple hydrophobia, without madness, or any desire of biting. This genus is equally misnamed, misplaced, and misdescribed.

We can only offer a few observations upon such of this family of diseases as are of most importance from their danger or frequency of appearance.

Tetanus, trismus, Locked-jaw. The two species denominated by these names are in reality the same disease, varying only in extent. Tetanus sometimes comes on suddenly; more generally, however, a sense of stiffness, or slight twitchings, are first perceived in the neck; these gradually increasing, the motion of the head becomes difficult and painful; as the rigidity of the neck becomes more considerable, a sense of uneasiness is felt about the root of the tongue, which, by degrees, produces a difficulty or inability of swallowing; there is violent pain under the ensiform cartilage, which shoots to the back; when this pain arises, the muscles, particularly of the back part of the neck, are immediately affected with spasm, pulling the head strongly backwards, at the same time the muscles of the lower jaw become rigidly contracted, so that the teeth are firmly closed together; as the disease advances, the muscles of the whole spine are affected, and draw the body backwards, producing opisthotonos; at other times the muscles of the fore part of the body are affected, and emprosthotonos is the consequence; and when the antagonist muscles of the whole body are so contracted, that the patient can bend himself in no direction, but remains as stiff as the trunk of a tree, the disease is called tetanus, which is, however, not so common a form of it, as the one we are now giving a description of; the abdominal muscles become violently affected with spasm, so that the belly is strongly retracted; at length the whole of the muscles of the head, trunk, and extremities, become strongly affected, and the body is rigidly extended, as above described; the tongue is often partially attacked with spasm, and is often thrust out violently between the teeth; at the height of the disease, every organ of voluntary motion suffers, in a greater or less degree, and in particular the muscles of the face; the forehead is drawn up into furrows, the eyes are hollow, distorted, rigid, and immovable, the nose is drawn upwards, and the cheeks are drawn backwards towards the ears, so that the whole countenance expresses a most ghastly appearance, and in this state violent convulsions supervene, and put an end to life. The spasms are attended with violent pain, and generally last for a minute or two, and as the disease advances, they are often renewed every quarter of an hour, and sometimes terminate in general convulsions; there is seldom any fever; but when the spasms are violent, the pulse is contracted, hurried, and irregular, and the respiration is alike affected, and there is sometimes an interruption of the breathing and convulsive hiccup; in the remissions, the pulse and respiration are natural, the heat of the body is commonly not increased, the face is generally pale, with a cold sweat upon it; the extremities are generally cold, and there is frequently a cold sweat over the whole body; sometimes, however, when the spasms are very frequent and violent, the pulse becomes full and frequent, the face is flushed, and a warm sweat is diffused over the whole body: it is a very remarkable circumstance, that neither the mental nor natural functions are considerably affected, there is seldom delirium, or confusion of thought, the appetite remains good, the urine is sometimes suppressed, or is voided with difficulty and pain, and there is costiveness. It is remarked by Dr. Blane, that the convulsive twitchings are sometimes even accompanied with pleasure.

This disease often proves fatal before the fourth day; after that period there is generally less danger; but, although there may be some abatement of its violence, it is apt to return with renovated force, a favourable termination of it is sometimes attended with a sensation of stupor, or formicatio, and a sense of itching; more frequently, however, it goes off, without any evident crisis; the danger will, therefore, be determined by the violence of the attack, and frequent recurrence of the spasms and general convulsions.

The *removal* of this disease must be attempted by administering opium in moderate but frequent doses, and where the deglutition is performed with any difficulty, it should be thrown in by clyster; wine is a most valuable auxiliary, but it should be taken in large quantities, and it will be more serviceable when given in combination with opium; bark is recommended, but it does not appear to have answered the sanguine expectations that were to be wished for; mercury is often of service, provided it is pushed so far as to affect the mouth; the warm bath, or a bath composed of milk or oil, has been recommended, and has sometimes succeeded; when employed in combination with opium, the heat of the bath is ordered to be lowered or raised, so as to afford the sensation of gentle and comfortable warmth; the most powerful remedy, however, appears to be immersion in the cold bath, in the paroxysm of convulsion, taking care to have some warm blankets in readiness, and immediately after the patient is taken out of the bath, he should be well rubbed with warm flannels, and put to bed; opiate frictions are particularly recommended, as the medicine can in this way be introduced into the system more readily, and without increasing the frequency of the spasms, which frequently occur during the efforts of deglutition; the combination of opium with æther is also of great service; the diet should consist of milk and broths, and if the nourishment cannot be received by the mouth, it should be thrown up by clyster. If the disease have arisen in consequence of the partial division of a nerve, it should be cut through; and if from a wound, it should be dilated, and filled with stimulating applications, as lint, moistened with the oleum terebinthinæ; and we must avoid exposure of the part to a current of cold air: the pain under the ensiform cartilage, and the spasms in general, will most commonly be relieved by applying cloths dipped in æther, and by gentle and uniform pressure on the parts suffering from spasm, by means of bandages, on which the æther should be poured occasionally, guarding, however, against the cold produced by the too speedy evaporation of the æther. The trismus of infants is a disease most frequent in warm climates; it generally attacks infants, within the first fortnight after birth, more generally, however, before they are nine days old: as it, in our opinion, very frequently proceeds from a retention of the meconium in the primæ viæ, it will be highly proper, in the first instance, to exhibit gentle laxatives, afterwards wine and antispasmodics, and if we do not succeed by these means, it will be advisable to try the cold bath, and the remedies above recommended.

Epilepsy may be distinguished from other species of convulsions by the sopor, and by the abolition of the sensation of external impressions; from apoplexy, by the increased action of the muscles; from hysteria, by the absence of the globus hystericus, and by its not being attended with the fear of death. The symptomatic epilepsy is more easily cured than the idiopathic; the later in life epileptic fits are experienced, the more dangerous they may, in general, be esteemed, as the cause may be supposed to have been acquired by the patient's habits of life, or by the decay of some internal part: hereditary epilepsy is scarcely ever cured; the longer the continuance of the complaint has been, and the more violent and frequent the convulsions are, the more dangerous is the disease, particularly if the vital functions be much affected; sometimes, although not very frequently, a single violent paroxysm cuts off the patient: epilepsy sometimes goes off at the age of puberty, or on the appearance of the menses; an intermittent fever, or a cutaneous eruption, often removes the disease.

Treatment. Blood-letting will sometimes be of service in the paroxysm, if the disease has not been of long continuance, and the patient is in a plethoric state; in general, however, it is more advisable not to take away blood, but to trust to less debilitating remedies; immediately after the patient is attacked with a fit, we must endeavour, as far as possible, to prevent his receiving any injury from the violent agitation of his body; he ought, therefore, to be put into a bed, with his head raised, and to have any pressure, occasioned by ligatures about his neck, instantly removed; stimulants should be applied to the nostrils, as errhines, or volatiles, as the spiritus ammoniæ compositus, the spiritus ammoniæ succinatus, &c. and the spine should be rubbed with the æther, or with the linimentum ammoniæ fortius, or oil of turpentine; and they will be more serviceable, if combined with stimulants, as the oil of amber, or the tincture of cantharides: it will be proper to administer opiates, and other antispasmodics, by clyster, particularly musk, and valerian. In the intermissions we are to attempt the radical cure of the disease; when the disease is symptomatic of some primary affection, we must, by a particular attention to the attending symptoms, endeavour to discover the nature of that affection; and if we succeed in removing the primary affection, by the proper means adapted to its cause, the epileptic attacks will cease of course; the aura epileptica has been removed by a tight bandage being made round the limb, just above the part from which that sensation appears to proceed; we must direct the patient to carefully avoid the occasional causes which are within his reach, and the predisposition must be corrected, as far as lies in our power. When the disease is idiopathic, and appears to depend upon a plethoric state of the system, that must be removed or prevented by moderate exercise, an abstemious diet, and issues, or setons; if the disease appear to arise from any suppressed discharge, in particular the hæmorrhois, leeches should be applied to the hæmorrhoidal vessels, fomentations should be employed, and we should, at the same time, administer aloetic cathartics; after the plethoric state of the system is removed, the cure of the disease will be effected by antispasmodics: when the disease seems to arise in consequence of a debilitated state of the system, it must be strengthened by cold bathing, exercise, change of air, a nourishing diet, tonics, and antispasmodics; the most suitable tonics are, bark, oxide of arsenic, ammoniate of copper, sulphate of copper, oxide of zinc and chalybeates: the antispasmodics in most general use are, oil of cajeput (melaleuca leucadendron), æther, musk, digitalis, stramonium, belladonna or hyoscyamus, lunar caustic, and opium, which last is most assuredly the best and most efficacious antispasmodic; it should be administered in doses, proportioned to the age and constitution of the patient; a short time before the expected return of the paroxysm, the opium must be repeated at proper intervals, and it will be necessary to increase the dose in a gradual manner, in proportion to the violence or frequent recurrence of the fits: whatever antispasmodic is employed, it will be indispensably requisite never to allow its effects to cease on the system, and to continue its use for months, or even a year or two, after the violence of the disease is overcome, and the fits have ceased, in order to establish a new habit in the system; and it should, on no account, be left off all at once, but the dose should be gradually diminished, as the fits are very apt to return, on the discontinuance of the medicine, with increased violence and danger: it will not be improper to remark, that antispasmodics are employed with most advantage, a short time previous to the expected recurrence of the paroxysm, and when the fits recur during sleep, a full dose of an opiate should be given at bed-time; the application of a cataplasm, formed chiefly of tobacco, to the scrobiculus cordis, about half an hour before the expected return of the paroxysm, has sometimes prevented it, and this practice, repeated several successive days, at the expected periods, has destroyed the diseased catenation, and effected a permanent cure: if the disease appears to arise from sympathy, some instrument of terror should be kept in readiness, as the actual cautery, or something that will inspire horror, which will very frequently prevent the fits: should derangement of the primæ viæ, worms, dentition, or any other obvious exciting cause, be the means of occasioning the disease, it must be removed by laxatives, and other remedies adapted to its causes, and as the disease so frequently, in part, arises from the first mentioned cause, occasional emetics and gentle cathartics will be proper, in order to obviate any accumulation of irritating matter in the stomach and intestines: when the disease proves obstinate, especially in those who are advanced in life, or have been intemperate in the use of fermented, spirituous, or distilled liquors, we have every reason to suspect some derangement in the hepatic system; in which case it will be requisite to employ the hydrargyrus, to a greater or less extent, in proportion to its effects on the disease; and it will, if the patient is not in a very debilitated state, sometimes be of essential service to push mercury so far as to affect the mouth. A total change of habit and climate may also frequently be prescribed with great benefit.

Asthma. The paroxysms of this disease very frequently commence during or after the first sleep, with a sense of tightness and stricture across the chest, and a feeling of uneasy oppression in the lungs, impeding respiration; there is either no cough present, or it is not attended with any expectoration; the patient, if in a horizontal situation, is immediately under the necessity of getting into an erect posture, and of flying for relief to the open window; the difficulty of breathing for a time increases, and both inspiration and expiration are attended with a wheezing noise, the voice is weak, and the exertion of talking is more or less painful: after these symptoms have continued for some hours, a profuse sweat sometimes breaks out, the breathing becomes less laborious, and the cough, which, at the commencement, was not present, or was without any expectoration, now becomes more free, and a more or less copious secretion of mucus takes place, and the other symptoms abate, but there is a greater or less degree of tightness across the chest, and of difficulty of breathing, throughout the course of the day; towards evening, or about midnight, for several successive nights, the symptoms suffer an exacerbation, and a remission takes place towards morning; and after some days, on the expectoration becoming and continuing more copious, the paroxysms for a time cease altogether: the pulse is, for the most part, quick, weak, and small; and the urine, which, at the commencement of the paroxysm, was pale, on its remission becomes high-coloured, and often deposits a sediment; the face is sometimes, during the paroxysm, somewhat flushed and turgid, more commonly, however, it is pale and shrunk: asthma is very frequently an hereditary disease, it does not very commonly appear before the time of puberty, and chiefly affects the male sex; it is most liable to return in hot weather; this, however, is not always the case: the paroxysm is often preceded by lassitude, torpor, drowsiness, a sense of weight or pain of the head, and symptoms of dyspepsia.

Treatment. In the paroxysm, if the patient be young, and of a plethoric habit, blood-letting will be often of service, especially if employed in the early periods of the disease, but if it have been of long continuance, it is generally hurtful, but cupping between the shoulders is often of considerable service; gentle laxatives and clysters should be employed, at proper intervals, so as to keep the bowels regular; gentle emetics should on no account be dispensed with, and where a paroxysm is expected to occur in the course of the night, an emetic exhibited in the evening will generally prevent it: antispasmodics should be administered, in opium, asafœtida, æther, &c.; it will be necessary to assist and promote the expectoration by means of some of the following remedies, either alone, or perhaps a more preferable manner will be in combination, as milk of ammoniac or of asafœtida, the decoction of seneka, or a solution of spermaceti, with nauseating doses of tartar emetic, or with some of the preparations of squills: the carbonate of ammonia, and myrrh, are also medicines of considerable efficacy; but squills are, by far, the most valuable expectorant of any in the whole materia medica; a blister should be applied to the chest, the vapour of warm water should be inhaled, and its effects will be increased, if the water is impregnated with æther; warm pediluvia, or the warm bath should be ordered; the respiration of an atmosphere, mixed with hydrogen gas, or any other innocuous air, which might dilute the oxygenous gas, would be useful in spasmadic asthma, by decreasing the sensibility of the system, and preventing the recurrence of the paroxysms; the respiration of an atmosphere with an increased proportion of oxygen is recommended, in what is called the humoral asthma: in the intermissions, the remote causes should, as far as lies in our power, be carefully avoided; the use of fermented liquors, and particularly of distilled spirits, must be strictly inhibited; the diet should be light, of easy digestion, not flatulent, and the food should be taken in moderate quantities, taking care not to oppress the stomach; but when the disease has been of long continuance, a more full diet may be allowed; riding on horseback, or in a carriage, and more particularly a sea voyage, should, if convenient, be advised, or the patient should change the air, and try different situations, until, either by accident or by perseverance, he finds out a situation to live in, in which the disease is rendered less distressing, or is entirely removed; repeated blisters should be applied about the chest, or an issue be made in the neighbourhood; smoking tobacco is useful; and garlic or onions, by way of sauce, may also be found serviceable. Bark, chalybeates, and aloes should be had recourse to towards the close of the paroxysm.

Colic commences with an acute pain over the abdomen, the navel is twisted towards the spine, and the muscles of the abdomen are spasmodically contracted into separate portions, giving it the appearance of a bag full of round balls; there is vomiting of a bilious matter, obstinate costiveness, and generally coldness of the extremities; the urine is high coloured, is voided in small quantity, and with some degree of difficulty and pain; the disease is seldom attended with pyrexia in the first instance. Sometimes, however, an inflammation of that part of the intestine, where the disease is situated, supervenes, and aggravates the disease: when the peristaltic motion of the whole intestinal canal is inverted, the disease is called ileus, which is only to be regarded as a more violent degree of colic; it is, however, more apt to terminate in enteritis, or gangrene.

The *removal* of this disease will generally be effected by blood-letting, in the repetition of which we must be guided by the state of the pulse, violence of the attack, and strength of the patient; in all violent attacks of colic, if the patient be in tolerable vigour, it will not only be advisable, but prudent, to take away a moderate quantity of blood (except the disease arise in consequence of lead being received into the system), more particularly so if the pulse is full or hard, and there are any symptoms denoting a tendency to enteritis; it will, at the same time, be the means of relaxing the spasm, and procuring stools: the warm bath should be ordered, or the abdomen should be fomented, and strong peppers and spirits may be added to the fomentations; friction of the abdomen with warm oil, or bags filled with hot sand, or bladders filled with hot water, may be employed also with great advantage; blisters or rubefacients, together with warm pediluvia, will be requisite; antispasmodics should be administered internally, and where the disease has not been preceded by long costiveness, opium will be the most efficacious remedy, especially if vomiting prevents the exhibition of cathartics: where, however, the disease has been preceded by costiveness, the hyoscyamus will be found to be a more suitable remedy, as along with its narcotic it also possesses a gentle cathartic quality: cathartics must be ordered, and they will be more efficacious when given in combination; calomel, above all, ought never to be given alone; its operation is always rendered more certain and easy by combining it with other cathartics, and the addition of a few drops of some essential oil will, in a great measure, obviate their griping effects; laxative clysters must be ordered; at first they should be mild, and tolerably large; the addition of a portion of oil, or of a solution of Epsom salts, will be an useful auxiliary; and if we do not succeed in procuring the evacuation of the intestines by the above means, we must have recourse to the injection of the smoke of tobacco; or a more certain and efficacious remedy is, a decotion of tobacco, in the proportion of half a drachm to four ounces of water, to be thrown up as an enema. If all the above means prove of no avail, we must have recourse to mechanical dilatation, as, by administering one or two ounces of the hydrargyrus every hour or two; or a large quantity of warm water should be injected by means of a large syringe: when every purgative, and even all other means that are in most common use, have failed, the action of the intestines has sometimes been effectually excited by throwing cold water on the lower extremities.

The *Colica Pictonum vel Saturnina*, or Colic from Lead, differs from the species above described, in not coming on in so sudden and violent a manner, and also in its cause, that of lead taken into the body, under various circumstances, as by exposure to the action of it, or by drinking cyder, or other liquors impregnated with it; the disease generally commences with slight uneasiness in the bowels, or with a sense of weight, or of an aching, rather than an acute pain, about the naval, which is increased after eating; the pain remits, and is sometimes relieved by pressure upon the abdomen: this, however, is frequently not the case. After a time the pain increases, becomes permanent, and intolerably excruciating; there is retraction of the umbilicus, the integuments of the abdomen, and the intestines are violently contracted, and drawn towards the spine, and the spasms are often so obstinate, that it is with the greatest difficulty a clyster can be thrown into the rectum; the pulse is hard and tense, there is obstinate costiveness, and often strangury; after several attacks paralysis comes on, chiefly of the upper extremities, although there are numerous cases recorded, in which the lower are affected also, and sometimes it terminates in swellings of the joints, and loss of sight; sometimes, but more rarely, the disease is succeeded by paralysis after the first attack; the patients cannot rest in bed for the violence of the disease, and they find relief in walking about, if they have sufficient strength: those who have once laboured under this disease are very liable to relapse, in which case the disease comes on in a more violent manner than before.

and the recovery is then more slow, and less complete. In the removal of this violent disease, we must, in the first place, restore the intestines to their natural irritability, by the exhibition of a large dose of opium; we should then administer some cathartic medicine at proper intervals, as the sulphate of magnesia or soda, or the phosphate of soda, dissolved in broth, or some aromatic fluid, castor or almond may be given, combined with tincture of senna; and if the stomach be in a very irritable state, the medicines must be exhibited in the form of pills, for which purpose the calomel, joined with extract of jalap or colocynth, and a few drops of some essential oil, will be the most suitable; laxative clysters will be necessary, to which may be added some cathartic salt, or oil; the pain of the abdomen will be relieved by rubbing it with tepid oil, or by applying spiced fomentations, or by the warm bath, or by bags of hot sand, and similar antispasmodics; the application of a large blister to the abdomen is, however, a much more efficacious remedy. When we have relieved the urgent symptoms, the disease will, on its first attacks, be effectually removed by employing mercury internally and externally. Mercury must be pushed so far, as to occasion some affection of the mouth as soon as possible, and the system must be kept under the influence of mercury, in a greater or less degree, according to the violence of the disease, for two or three weeks after every symptom of the disease has disappeared, as it is very apt to return, and with increased force. As a disposition to costiveness often remains, it should be obviated by some of the above cathartics. It sometimes happens that the pain in the bowels shifts suddenly, and attacks the head, causing extreme misery: in this case nothing affords so much relief as blisters applied to the back, behind the ears, and to the temples, successively, according to the urgency or continuance of the pain: opiates may be administered at the same time with advantage. The paralytic affections, which are the consequence of this disease, and the ileus, will be removed by the internal and external employment of Bath waters.

In *diabetes*, the most prominent symptoms, according to Dr. Rollo, are voraciousness and keenness of appetite, or a frequent craving for food, without the feel of entire satiation; a parched mouth, with constant spitting of a thick viscid phlegm, of a mawkish, sweetish, or bitterish taste; intense thirst; a whitish tongue, with red bright sides: red and swelled gums, with the teeth feeling as on edge from acids, and loose in their sockets; a head-ach; a dry hot skin, with flushing of the face; a pulse most generally about eighty-four or six; an increase of clear urine of a light straw colour, having a sweetish taste, resembling sugar, or rather honey and water: an uneasiness of the stomach and kidneys: a wasting of the flesh, a weariness and disinclination to motion or exertion, with the feeling of weakness; an excoriation, with soreness of the glans penis, and prepuce, which is sometimes swelled, and there is no desire of venery: in females there is a peculiar uneasiness about the meatus urinarius.

The predisposing *causes* of this disease are at present obscure, but the disease has been found to occur in those who have indulged in fruits, sweetmeats, pickles, high-seasoned food, warm, stimulating condiments, wine and fermented liquors, or indulgence even in farinaceous foods, with large quantities of small beer, accompanied by great bodily exercise, with or without active mental employment; moisture, grief, vexation or agitation of mind; sudden variations of temperature may also be regarded as predisposing or exciting causes. The proximate cause is supposed to be a morbidly increased action of the stomach, with consequent secretion, and vitiation of the gastric fluid, marked by an eagerness of appetite and acidity; the direct effects of which are the formation or evolution of saccharine matter, with a certain degree of assimilation, preventing the healthy combinations, and exciting the immediate separation of the imperfectly formed chyle by the kidneys. Dr. Baillie thinks it probable, that diabetes depends, in a considerable degree, upon a deranged action of the secretory structure of the kidneys, by which the blood there is disposed to new combinations; the effect of these combinations is the production of a saccharine matter: he further thinks it probable, at the same time, that the chyle may be so imperfectly formed, as to make the blood be more readily changed into a saccharine substance, by the action of the kidneys; an opinion well worth minute inquiry.

The *cure* of this disease consists in confinement, an entire abstinence from every species of vegetable matter, a diet solely of animal food, and that in as small quantities as the stomach will be satisfied with; emetics, hepatised ammonia, and narcotics, will be necessary, and they should be assisted by the daily use of alkalies and lime water; the hepatised ammonia should at first be exhibited in doses of five or six drops, three or four times a day, the dose is to be gradually increased, so as to produce some degree of nausea, or slight giddiness; it should not be mixed up in draughts, or in any other form, as it is readily decomposed, but it should be dropped from the phial at the time of using it, into a proper vehicle, and taken immediately; distilled water is the best vehicle; an opiate should be administered at bed-time, with from twenty to thirty drops of the antimonial wine; this plan is to be pursued until the morbid condition of the stomach is removed, the marks of which are a scarcity and highly coloured state of the urine, with turbidness, furnishing, on evaporation, an offensively smelling and saltish-tasted residuum, without tenacity, accompanied with a want of appetite, and loathing of food: at this time the tongue and gums will be found to have lost their florid red colour, and to have become pallid. When this state occurs, exercise must be enjoined, and a gradual return to the use of bread is to be allowed, and vegetables, such as brocoli, spinach, peas, cauliflower, cabbage, lettuce, and parsnip, in moderate quantity: these last have been observed to have been eaten with impunity. The drink should consist of such liquors as afford the least saccharine matter, as weak brandy or rum and water, with the occasional use of bitters. Costiveness must be obviated by gentle laxatives, as flowers of sulphur, oil of castor, or aloetics combined with soap. The exciting and keeping up a degree of nausea, with proper doses of tartar emetic, is recommended in the early stages of the disease; the camphor and other narcotics, besides opium, are deserving of a trial; alum whey, which is made by boiling a drachm of the alum in a pint of milk, is said to considerably reduce the quantity of urine; nut-galls and lime-water have been employed with success.

ORDER IV. *Vesaniæ*. INTELLECTUAL DERANGEMENTS.

Disorders of the judgment without pyrexy or coma. The following are the genera. 1. Amentia; an imbecility of judgment, by which people either do not perceive, or do not remember, the relations of things: the species are three; connate, from old age, from evident external causes. 2. Melancholia, a partial madness, without dyspepsy or indigestion; varying according to the different subjects concerning which the person raves; and hence admitting an almost infinite multiplicity of varieties. 3. Mania, universal madness; idiopathic and symptomatic; under the former section, mental and corporeal, or arising from some evident disease of the body: under the latter, proceeding from poisons, from passion, from febrile affection; and hence rather referable to the corporeal species. 4. Oneirodynia, a violent and troublesome imagination in time of sleep. Two species; O. activa, somnambulism, or sleep-walking: and O. gravans, nightmare.

To *Mania*, with which Melancholia is so nearly allied, we shall devote an observation or two.

Mania often arises from intense study, violent emotions of the mind, unrestrained passions, long exposure to the scorching rays of the sun, overstraining the faculties of the mind, intemperance, organic affections of the cranium, and hereditary disposition, sanguine temperament, long continued melancholy, suppressed evacuations, repelled eruptions, and religious enthusiasm. The proximate cause is supposed to consist in an increased excitement of the brain. It is distinguished from phrenitis by the absence of the pyrexy and head-ach, and from delirium by the state of the pulse, by the patient not knowing the place where he is, nor the persons of his friends or attendants, and from not being conscious of external objects, except when roused, and even then he soon relapses into a state of inattention; whereas, in mania, he is frequently sensible, and is continually planning the means of preventing or revenging supposed injuries, and frequently the resentment is directed against his dearest friends.

Treatment. According to Dr. Darwin, the circumstances which render confinement necessary are, the lunatic being liable to injure others, or himself, or not being able to take care of his own affairs; and if none of these circumstances exist, there should be no confinement: for he remarks, though the mistaken idea continues to exist, yet if no actions be produced in consequence, the patient cannot be called insane, but only delirious: and he adds, that if every one who possesses mistaken ideas, or who puts false estimates on things, were liable to confinement, he does not know who of his readers might not tremble at the sight of a mad-house. It will, however, in the first instance, always be proper to gain a complete ascendency over the patient, either by gentle or coercive measures; his anger and violent passions must be restrained by the straight waistcoat; he should be kept in silence and darkness, and as much as possible in an erect posture; none of his intimate acquaintance or friends should be allowed to visit him. At the commencement of this disease, blood-letting may be employed with advantage; the blood should be taken from a large orifice, in such quantity as to induce some tendency to deliquium animi: when the temporal artery or jugular vein, can be conveniently opened, it should be preferred. If the disease have been of considerable duration, bleeding will not be advisable; a solution of the gum ammoniacum with Glauber's salts should be given daily, so as to keep the bowels pretty laxative; the head should be shaved, and cloths moistened with the coldest water, pounded ice, or water artificially rendered so, should be gently wrung, and applied constantly to the head; they should be renewed as soon as they acquire any heat, until a sense of cold and chilliness be induced, when they are to be left off, and had recourse to again when necessary, or the affusion of cold water upon the head may be substituted; it should be poured from a considerable height: it is recommended to put the patient into the warm bath up to his shoulders, and then to pour cold water upon the head, previously shaved; vomits, consisting of from five to ten grains of tartar emetic, are recommended to be given every three or four days, for two or three weeks; opium and camphor have been employed in large doses, and frequently with advanage; the digitalis has been found particularly serviceable; it should be exhibited in gradually repeated doses, and continued until a degree of sickness is induced, or till the frequency of the pulse suffers a considerable diminution; it must then be left off, and again renewed when its effects on the constitution begin to wear off; the gratiola has been recommended in doses of ten grains, two or three times a day; hard labour, and long continued journeys have, in some instances, effected a cure; it is proper to remark, that the pulse in mania is sometimes full and strong; when this occurs, evacuations and diluents will be necessary; at other times, the pulse is quick and weak; in this case, a more nourishing diet, bark, chalybeates, and small doses of opium, will be proper; in general, the patient should be allowed only a low and spare diet; blistering has not been found of service, except at the commencement of the disease; the affusion of warm water on the surface of the body, that is, water of the temperature of the blood and upwards, is often employed with soothing effects. The cold bath is strongly recommended in the height of the paroxysm, except the digestion is much impaired, or the vigour of the circulation is much debilitated: the patient should be thrown in headlong, and as he comes out he should be thrown in again, until he becomes calm and rational, or very much debilitated. Though in mania the temperature of the body is little, or not at all, increased, maniacs retain the actual heat with great tenacity; and under the above restrictions the cold bath may often be applied with advantage, and always with safety. After the disease is removed, it will be proper to administer bark, chalybeates, the oxide or sulphate of zinc, and the sulphuric acid.

CLASS III. CACHEXIÆ.

DEPRAVED HABITS.

A depraved habit of the whole or greatest part of the body, without primary pyrexy, or neurosis. The following are the orders of this class.

ORDER I. *Marcores.* DECLINES.

This order includes the following genera: 1. Tabes; leanness, debility, hectic, pyrexy. Three species: purulent, scrophulous, and from poisons taken internally. 2. Atrophy: differing from tabes in being without hectic pyrexy. The species are, from too great evacuation, from a deficiency of nourishment, from corrupted nourishment, from decay of the nutritive organs.

In *tabes* and *atrophy* the cure may best be effected by the removal of the remote causes, or the idiopathic diseases on which they depend; the tabes mesenterica is sometimes an idiopathic disease, in which there is great debility, emaciation, and paleness; there is, at the same time, enlargement of the head and abdomen; it will be effectually removed by small doses of calomel, or of the murias hydrargyri, the doses must not be so large as to excite catharsis: the mercury is intended only to act as an alterative; the solutio muriatis calcis is deserving of an unbiased trial; the cure will be accelerated, if we, at the same time, employ chalybeates, combined with a neutral salt, with fossile alkali, or with rhubarb, in such doses as to act moderately upon the bowels; the employment of a tepid salt-water bath, or washing the patient with a solution of salt, night and morning, will also be of service.

Order II. *Intumescentiæ.* Morbid Swellings.

An external tumour of the whole or greater part of the body. These are adipose, flatulent, or aqueous, forming three distinct sections. Of the first is, 1. Polysarcia, corpulency. Of the second are, 2. Pneumatosis, a tense elastic swelling of the body, crackling under the hand. 3. Tympanitis, a tense, elastic, sonorous swelling of the abdomen, costiveness, a decay of the other parts. Two species: intestinal, and abdominal. 4. Physometra, a slight elastic swelling in the epigastrium, having the figure and situation of the uterus. Under the third section we have, 5. Anasarca, a soft inelastic swelling of the whole body, or some part of it; arising from a multitude of causes, and hence admitting of a multitude of species. 6. Hydrocephalus, a soft inelastic swelling of the head, with the sutures of the cranium opened. 7. Hydrorachitis, a soft slender tumour above the vertebræ of the loins; the vertebræ gaping from each other; formerly denominated spina bifida. 8. Hydrothorax, dropsy of the chest; dyspnœa; paleness of the face; œdematous swellings of the feet; scanty urine; lying down difficult; a sudden and spontaneous waking out of sleep, with palpitation; water fluctuating in the chest. 9. Ascites, a tense, scarcely elastic but fluctuating swelling of the abdomen. Two species: one A. abdominalis, extending over the whole abdomen, with an equality of tumour, and a fluctuation sufficiently evident, arising from an obstruction of the viscera, from debility, or from thinness of the blood; the other, A. saccatus, confined in a bag, the swelling more partial, and the fluctuation less evident. 10. Hydrometra, dropsy of the womb, a swelling of the female epigastrium, gradually increasing, preserving the shape of the uterus, yielding to pressure, and fluctuating, without ischury or pregnancy. 11. Hydrocele, swelling of the scrotum, not painful, increasing by degrees, soft, fluctuating, and pellucid. 12. Physconia, a swelling chiefly occupying a certain part of the abdomen, and neither sonorous nor fluctuating. The species are very numerous, and named from the part the disease occupies, whence we have physconias, hepatic, splenic, venal, uterine, &c. 13. Rachitis, rickets, a large head, swelling most in the fore-part, the ribs depressed, abdomen swelled, with a decay of the other parts. It varies merely in being simple, or conjoined with other diseases.

From this list it will appear obvious, that a preternatural collection of serous, or watery, fluids is often formed in different parts of the body; and although the disease arising from it is distinguished by different names, according to the various parts occupied, these collections all come under the general appellation of dropsy. When water is diffused through a part or the whole of the cellular membrane, the disease is called anasarca: when there is a collection of water within the cavity of the cranium, it is named hydrocephalus internus; when upon the vertebræ of the loins, it is called hydrorachitis; when within the cavity of the thorax, it is named hydrothorax; when it is contained within the cavity of the abdomen, it is called ascites; when in the uterus, hydrometra: and when it is collected within the scrotum, it has the appellation of hydrocele. We can only notice a few of these.

The removal of *anasarca* must be attempted by removing the remote causes which still continue to act, by evacuating the collected fluid, and by restoring the strength of the system. The remote causes are often such as have been removed before the disease occurs although their effects continue; for the most part, these causes are certain diseases, or habits, previous to the occurrence of the disease, which are to be cured by proper remedies, adapted to their causes, and by desisting in particular from indulgence in the use of ardent spirits, when the origin of the disease can be traced from that source; the collected fluid must be drawn off by scarifications, the punctures of which must be made small, and at some distance from one another, as there is a tendency in wounds, made in dropsical cases, to become gangrenous; issues, or the daily application of a thin slice of mezereum, steeped in vinegar, will be proper; they should be made a little below the knees; colewort leaves should be applied to the feet and legs, which must be removed occasionally as they become imbued with moisture; or booterkins should be made of oiled silk, and bandages should be applied to the lower extremities; emetics are also very serviceable, they should consist of ipecacuanha, tartar emetic or squills, with a few grains of the sulphate of copper; the most powerful remedies, however, are cathartics, which dropsical patients in general bear more easily than emetics; those in most general use are, gamboge, jalap, colocynth, scammony, calomel, and elaterium: this last should be exhibited in the form of a pill, or given in diluted spirits, in doses of half a grain or more, every hour, until vomiting or catharsis is excited; but the most powerful remedy is the crystals of tartar, which should be administered in doses of two drachms every hour, till copious evacuations are procured either by stool or urine, giving at the same time tepid liquids plentifully; this medicine should be repeated every, or every other, morning, according to the strength of the patient. As the thirst is a very distressing symptom in this disease, the patient should be allowed to take as much water, or mild mucilaginous liquids, acidulated with the crystals of tartar, as he feels disposed for; bottled cyder, drank in considerable quantities, is sometimes of service; diuretics must be administered, and they should be combined with tonics and aromatics, or with essential oils. The most powerful medicine of this class, however, is the digitalis, and it is most efficacious when joined with some of the above diuretics; it should be given in such doses as to affect the state of the pulse, and if it do not speedily afterwards act as a diuretic, it will be of little avail to persevere in its exhibition; as the perspiration is often greatly diminished, diaphoretics have sometimes been employed with advantage, or opiates combined with ipecacuanha, and the action of the vessels upon the surface will be excited by friction, particularly in the morning, and it will be more serviceable if made from below upwards; if the above methods should be of no avail, we must try mercury, and it should be pushed so far as to affect the mouth, and its effects on the system must not be allowed to cease until the swelling subsides. The debility of the system will be removed by studiously avoiding all the remote causes in our power, by gentle exercise, by supporting the integuments of the lower extremities by means of bandages properly applied, as a well-constructed laced stocking, and by the employment of bark, quassia, sulphuric acid, and chalybeates, and they will be more efficacious when combined with diuretics; the vapour-bath has been employed with considerable advantage, especially when assisted by frictions; if the disease arise in consequence of obstructions of the viscera, or syphilis, some of the preparations of mercury will be necessary, employing at the same time chalybeates and tonics. The pulse has been sometimes, although rarely, found full, hard, and tense, in which case blood-letting is advisable.

Hydrocephalus generally attacks children, and very often comes on in a very gradual manner; one of the earliest criterions is, the patient being uneasy on raising his head from the pillow, and wishing to lie down again immediately; it frequently commences with languor, pains in the limbs, and head-ach; the patient is affected with nausea and vomiting several times in the course of the day, the pain of the head is usually confined to one side, or extends from just above the eyebrows to the temples; sometimes, however, it is universal over the whole of the head; the head-ach frequently alternates with the affection of the stomach, and the head is now and then observed to lean more to one than the other side; the eyes are painfully sensible to the light, there is moaning and watchfulness; or, if the patient sleep, he grinds his teeth, picks his nose, and often awakes suddenly in a fright; the bowels are costive, and are with difficulty acted upon by the strongest purgatives; the pulse is more frequent than in health, but regular; these symptoms go on increasing, the pupils become dilated, and the axes of the eyes are turned in different directions; the vomiting and pain of the head become more distressing, there is some difficulty of breathing, the heat of the body, and of the head in particular, is increased, pyrexy comes on, of which there are perfect intermissions many times in the course of the day, with an evident exacerbation in the evening; the countenance is occasionally flushed, and the pulse, from being frequent, now becomes slow and irregular; as the disease advances, the pain of the head somewhat abates, and a degree of stupor or coma succeeds the watchfulness of the former stage, and if the patients be roused, they are fretful, and often utter dissonant and loud screams, the hands are often lifted up to the head, and the strabismus becomes more considerable, the pupils are more dilated, and scarcely contract when exposed to a strong light; sometimes there is a total defect of vision; they swallow liquids with unwillingness and some apparent difficulty; the vomiting now ceases, the disposition to costiveness continues; now and then, however, dark stools are evacuated, in which worms are frequently observed;

when the disease has continued in this state for a few days, the pulse again becomes regular and frequent, but very weak; the breath is drawn with difficulty, and with a stertorous noise, the patient is frequently affected with loud shriekings, red spots appear on different parts of the body, particularly about the joints, and at length convulsions come on, and close the scene.

Treatment. As this disease frequently runs rapidly to its fatal termination, we must employ the most active remedies in the first stage: the most powerful remedy, at the commencement of this deplorable disease, is blood-letting: in children it will be sufficient to apply leeches to the temples at proper intervals; in adults we may, with great propriety, employ general blood-letting; commonly, however, local blood-letting will be most serviceable; costiveness must be obviated by the more active cathartics, as calomel, combined with gamboge, scammony or elaterium, and by the employment of clysters; the head should be shaved, and a large blister applied over the whole of it, or between the shoulders; it will be proper to keep up the discharge occasioned by the blister for some time, in which case an alternation of them from the head to the back, or behind the ears, will be attended with more beneficial effects than a perpetual blister; the velocity of the circulation will be diminished by the exhibition of the digitalis, and if we have reason to conclude that an effusion has taken place, the absorption of the fluid will be promoted by combining the digitalis with calomel; the latter must, however, be administered at proper intervals, in such doses as will produce some affection of the mouth; opiates should be given at the same time, and if the patient be very much debilitated, it will be proper to exhibit bark and chalybeates: errhines may be tried, as one grain of turbeth mineral, mixed with from ten to fifteen grains of sugar, or liquorice powder; this should be gradually blown up the nostrils; frequent electric shocks, from very small charges, are recommended to be passed through the head in all directions. The hydrocephalus is sometimes symptomatic of worms, disorders of the bowels, or mesenteric affection; when this is the case, the disease will generally be removed in a short time, by the employment of mercurial cathartics, combined with other active purgatives, by blisters, and by some of the preparations of iron.

Rachitis. This disease seldom makes its appearance before the eighth or ninth month, or after the second year of the child's age; it appears first with a flaccidity of the muscles, and falling away of the flesh, although the food is taken in large quantities. If the child be able to walk, a difficulty of breathing and palpitation of the heart will be perceived on its walking a little faster than usual; the face is pale, and somewhat bloated, and the child becomes daily more averse to exercise or motion; the head appears large in respect to the body, and the forehead becomes unusually prominent; the fontanelle and sutures are more open than usual, the ribs lose their convexity, and become flattened at the sides, and the sternum is pushed outward and forms a sort of ridge; the joints become enlarged, while the limbs between them appear, or become slender, and variously distorted; the spine of the back, in particular, becomes very much incurvated, and the whole figure is sometimes distorted in such a manner as to resemble the letter S; the abdomen is hard and preternaturally tumid, and the other parts of the body are emaciated; the appetite is but little, or not at all, impaired, and the stools are frequent and loose; the dentition is not only slow, but later than usual, and the teeth, soon after their appearance, become decayed, and frequently fall out; the faculties of the mind are sometimes impaired; more frequently, however, they possess a premature acuteness of the understanding. On the first appearance of the disease the system is but little affected, but after a short time febrile symptoms are generally present: the disease after a while often ceases to advance, and the health is re-established, but the limbs remain distorted; in other cases, it goes on increasing till every function is affected, and at length terminates in death, in consequence of inability to distend the chest, owing, in all appearance, to the softness of the bones. In the bodies of those who have died of this disease, various morbid affections have been discovered, in the internal parts in particular; the abdominal and thoracic viscera have been found in a diseased state, and the bones are sometimes so soft that they can be readily cut through with a knife.

The remote causes are, debility, an impure and humid state of the atmosphere, poor milk, hereditary disposition, bad air, deficiency of proper exercise, want of cleanliness, and an improper diet. The proximate cause is supposed to be a deficiency of calcareous earth and phosphoric acid.

The *removal* of this disease will be effected by gentle emetics in the first instance; it will not, however, be necessary to repeat them very frequently: bark should be administered in moderately large doses; but there is often a difficulty in administering it in substance, in proper quantities; the extract of bark is to be preferred, or the oxide or sulphate of zinc, or some of the preparations of iron must be employed, and they will be more efficacious if administered in combination with calcined hartshorn or chalk, or with a neutral salt and rhubarb, in such proportion as will keep the bowels gently laxative; the phosphate of lime and of soda are recommended, in equal parts, to the extent of a scruple, twice a day; and washing the surface of the body with a solution of potash, in the proportion of half an ounce to a pint of water, morning and evening, is also of service, taking care, however, to wipe the skin perfectly dry; the body must be well rubbed with flannel, and the dorsal spine should be rubbed with volatile alkali; the diet should be light and nourishing, and port wine should be allowed; exercise in the open air, in dry weather, should be strictly enjoined, and as gestation can only be employed, the child should always be carried in a horizontal posture, as moving them in any degree of an erect one is liable to increase the distortion, and they should lie down frequently in the course of the day; and some of the ingenious contrivances, mentioned in the Zoonomia, should be employed. The cold bath may be made use of, or a bath of the temperature of the Matlock bath, which is 66°, or of the Buxton, which is 82°, would perhaps be preferable, and more beneficial. The prophylaxis consists in cold bathing, frictions, and proper exercise.

ORDER III. *Impetigines*. EXTERNAL DEFORMITIES.

Cachexies, chiefly deforming the skin and external parts of the body.

The following are the genera of this order: 1. Scrophula, king's evil: swellings of the conglobate glands, especially in the neck; swelling of the upper lip and support of the nose; the face florid, skin thin, abdomen tumid. Four species: common, mesenteric, temporary, from resorption of the matter of ulcers in the head; and West Indian, catenated with the yaws. 2. Syphilis, venereal disease, a contagious malady after impure venery, and a disorder of the genitals; ulcers of the tonsils, of the skin, especially about the margin of the hair; corymbous papulæ, terminating in crusts and crusty ulcers; pains of the bones and exostoses. 3. Scorbutus, scurvy. In cold countries attacking after putrescent diet, especially such as is salt and of the animal kind, and when there is no supply of fresh vegetables; asthenia; stomacace; spots of different colour on the skin, for the most part livid, and appearing chiefly among the roots of the hair. 4. Elephantiasis, Arabian leprosy, a contagious disease; thick, wrinkled, rough, unctuous skin, destitute of hairs; anæsthesia in the extremities; the face deformed with pimples; voice hoarse and nasal. 5. Lepra, Greek leprosy, skin rough, with white branny and chopped escars, sometimes moist beneath, with itching. 6. Frambœsia, yaws, swellings resembling funguses, or the fruit of the mulberry or raspberry, growing on various parts of the body. This disease is placed by some nosologists in the class and order Pyrexiæ. Exanthemata, as constantly accompanied with pyrexy, and only attacking a man once during life. 7. Trichoma, bleeding hair, a contagious disease; the hairs thicker than usual, and twisted into inextricable knots and cords. It is almost confined to certain parts of the north of Europe, and rarely extends out of Poland. 8. Icterus, jaundice; yellowness of the skin and eyes; white fæces; urine of a dark red, tinging what is put into it of a clay colour. Five species; calculous, spasmodic (after spasmodic diseases of the mind); hepatic, from pregnancy; and infantile, attacking infants a few days after birth; for which last see the article INFANCY.

Scrophula. The symptoms are known too generally. The most efficacious remedies which can be employed are, sea bathing, and the internal use of salt water, a change to a warm climate, and a nourishing diet. A trial of the chalybeate and sulphureous waters should be recommended; the digitalis and a solution of muriate of barytes have often been administered with evident advantage; the latter appears to be a medicine well calculated to correct the scrofulous diathasis; bark, combined with carbonate of soda, is strongly recommended; the preparations of iron should be ordered, and a small quantity of rhubarb should be joined with them; a grain or more of opium, twice a day, is sometimes of service; hemlock is getting into disuse, perpaps undeservedly.

The external remedies most suitable for scrophulous tumours and ulcers are sea water poultices, and bruised seatang; the leaves of wood-sorrel (oxalis acetosella) bruised, are strongly recommended, and appear to have been employed with advantage; linen rags, kept constantly moistened with a solution of the sugar of lead, or of muriated mercury, should be applied to the parts affected; a small quantity of a powder composed of seven parts of bark, with one part of white oxide of lead, is recommended to be applied to scrofulous ulcers, by means of lint and a bandage, and renewed daily; or they may be sprinkled with carbonate, or oxide of zinc; it will be proper always to apply moderate pressure upon the parts, which will tend to heal the ulcers; oxygen gas has been employed with evident advantage; electricity might perhaps produce good effects, if had recourse to at the commencement of the disease; the solution of muriate of lime is strongly recommended, and it is certainly deserving of a full and fair trial; the dose should be gradually increased, and when qualms and sickness are produced, we may consider these as signs of an over-dose; it is also proper to observe, that it is sometimes necessary to employ gentle laxatives under its use, as it is apt to induce costiveness.

Scorbutus. Soreness of the gums, with a spongy swelling, and bleeding upon the least touch; the face lurid, bloated; ancles œdematous; lassitude and depression of spirits; pains in the limbs and thorax; the hands contracted and rigid; the debility increasing, so that at length a simple attempt to acquire an erect position is productive of syncope, or even death; the appetite for food is generally unimpaired; in every stage of the disease the skin becomes dry and rough, and the urine is scanty and high coloured; vibices appear in different parts of the body, and there are small specks, generally of a purple colour, very little raised above the surface of the skin, and if a part be bruised, in any stage of the disease, ecchymosis immediately takes place; the pulse is generally weak, the tongue is of its natural appearance, the bowels are either very much confined, or the patient is troubled with diarrhœa, accompanied with griping pains. In the last stage of the disease the breath becomes remarkably fetid; the urine, after it has been voided some hours, is covered with an oily pellicle; and blood issues from the mouth, nose, anus, urinary passages, sometimes even from the ends of the fingers and pores of the skin. There is a remarkable symptom sometimes attendant on this disease, even in its incipient state, mentioned by Dr. Blane, in his valuable work on the Diseases of Seamen, in which the patient complains of an almost total blindness towards evening, when no other visible symptom of the disease is present; but the complaint uniformly betrays itself by ecchymosis, in cases of bruises, or by scorbutic ulcers, which are very difficult of cure It chiefly affects sailors, and people shut up in besieged places, who are deprived of fresh provisions and vegetables; this, however, is not always the cause, as, in cold climates, it is sometimes produced by a very scanty, though not salt diet, under the influence, at the same time, of cold, damp, and foul air, and indolence.

Treatment. This disease will be most certainly removed by fresh vegetables, and the expressed juice of lemons, limes, oranges, and other subacid fruits; the two first are, however, the most powerful antiscorbutics; and it is worthy of remark, that the recovery will be more speedy when fresh vegetables alone, and no animal food are employed, than when fresh animal food is made use of without vegetables: the essence of malt, or of spruce, will often be found of considerable service. As there is generally an obstruction of the perspiration, we should endeavour to excite a gentle diaphoresis by means of the pulvis ipecacuanhæ compositus, or by camphor, combined with nitre and opium; vegetables are particularly useful, such as celery, watercresses, cabbages, mustard, horse-radish, and many others of the class Tetradynamia. As a free flow of urine is found to promote recovery, we should endeavour to solicit it by means of some of the preparations of squills; wine, chalybeates, bark, and the mineral acids, should be exhibited; when lime or lemon juice cannot be procured, sourkrout, and what in Scotland is called souins, are very useful articles of diet: a solution of nitre in vinegar, in the proportion of from two to four ounces of the former to a quart of the latter, is strongly recommended; from one to two ounces, or more, may be given two, three, or four times, in the course of the day. The sponginess of the gums will be removed by a solution of the alum, or by astringent gargles, in which muriatic acids is a component part: the contraction of the hams, and the livor and hardness of the calves of the legs, will be relieved by warm fomentations and emollient poultices. A poultice of wood-sorrel should be applied to the ulcers, or, if that cannot be procured, the nitrous vinegar may be employed; but the best application is lemon juice. The remote causes must, as far as lies in our power, be avoided; the greatest attention must be paid to cleanliness; exercise must be enjoined; and the air must be corrected by fires and ventilation. The only certain preventatives are, fresh vegetables, exercise, and the nitric acid. Oxygen should be introduced into the system, by such medicines as are known to contain it, or by inspiring it when chemically produced.

Jaundice is easily discovered from the yellow hue it produces. The cure consists in the removal of the exciting causes, and the alleviation of urgent symptoms; the most frequent exciting causes are calculi, the passage of which will be promoted by gentle emetics; for this purpose ipecacuanha is the best medicine; it should be exhibited in small and divided doses, so as to occasion, for a time, a degree of nausea, but ultimately to produce its full effects: the costiveness must be removed by the calomel, combined with rhubarb and soap, or by administering oil of castor. Where the pain is very violent, attended with a slow pulse, the warm bath, and fomentations of the epigastrium, will be necessary, or bladders filled with hot water, or bags of hot sand, applied to it; opiates will be very serviceable, but as there is costiveness, the inspissated juice of henbane would be a preferable medicine; æther with yolk of egg, is recommended, as having a tendency to dissolve inspissated bile; unboiled acrid vegetables are useful, as lettuce, mustard, cresses, &c.; electric shocks should be passed through the duct at proper intervals; mucilaginous diluents should be freely allowed, and emollient clysters should be frequently injected. In cases of pyrexy, attended with local pain, and dyspnœa, blood-letting and the antiphlogistic regimen may be employed with great advantage; and after the pain is removed, and the arterial energy becomes weakened, some of the preparations of iron may be used with great benefit; Seltzer, or soda water, should be drank in moderate quantities, or it may be made at the time of taking it by dissolving a drachm of the carbonate of soda in a pint of water, and adding twenty drops of muriatic acid, drinking it off as soon as mixed; or, instead of the muriatic acid, it may be saturated with carbonic acid, by means of Dr. Nooth's glass apparatus. There is an artificial sort of Seltzer water sold in London, which is prepared in a much better manner than we are able to do it in general; and the name of the proprietor is Schweppe. If the disease arise in consequence of tumours, or pressure of surrounding parts, small doses of calomel, or some other preparation of mercury, may be useful, employing, at the same time, some of the preparations of iron, or natural chalybeate waters; gentle exercise on horseback is particularly serviceable in promoting the passage of calculi, and preventing the stagnation of bile in the gall-bladder.

CLASS IV. LOCALES.

LOCAL AFFECTIONS.

A reference to the nosological table of the system we have selected in this work will prove this class to be of a very voluminous, as well as of a very complicated nature: and, as we have already observed, intended to take in every disease which could not easily be introduced under the preceding classes. More than half the maladies of which this class consists belong to the department of surgery; such as, for instance, all the genera in the order Tumores, and many of those in the order Dialyses. Of the rest, many are altogether incurable, and many may more conveniently be described under the article MIDWIFERY. On this account, instead of giving a detail of the entire genera of which the present class consists, with their definitions and modes of treatment, we shall refer the reader to the previous table for their respective names and arrangements; and shall only select, for further remark, those that appear of more prominence and general importance than the rest, and which can only with propriety be described in the present article.

Amaurosis, loss of sight, without visible cause or injury. In this disease the eyes appear natural; but the pupil is dilated, and does not contract upon being exposed to the strongest light: it is sometimes attended with head-ach. The remote causes are, compression of the brain, either from congestion or mechanical pressure; cataract; atony; paralysis of the optic nerve, or irritability of it. The proximate cause is the insensibility of the retina If the disease arise from the first mentioned cause, it may be removed by the means necessary in those cases: when it arises from atony, or paralysis of the optic nerves, we must employ stimulants, as blisters to the temples; electricity is of singlular service; sparks should be taken from the eyes, and shocks should be sent through the head; errhines will be very useful, as turbeth mineral, in the proportion of a grain to eight of liquorice powder, one fourth of which is to be snuffed up the nostrils once or twice a day; and we must at the same time employ the internal stimulants recommended in the treatment of paralysis: opium and muriated mercury, in doses of a quarter of a grain of each twice a day, a blister on the crown of the head, and repeated minute electric shocks, passed through the eyes, are recommended in the early stages of this disease. The cataract, as requiring a surgical operation, does not properly come under consideration.

Albugo, or opacity of the transparent cornea, which often remains after inflammation or syphilis, may sometimes be removed by repeated blisters on the temples. The long continued use of electricity, and the aqua ammoniareti cupris, should be introduced into the eye, and it will sometimes require dilution; or prepared glass reduced to an impalpable powder in a mortar of agate, and mixed with honey or mucilage, is to be applied to the eyes, by means of a camel hair pencil, two or three times a day. The linimentum sepiæ compositum, and infusion of Guinea pepper, are recommended in strong terms, and are certainly deserving of a trial.

Of *deafness* the causes are innumerable. It may be a defect in the organ of hearing, too great dryness of the ear, hardened accumulated wax obstructing the passage of sounds; inflammation of the membrana tympani; inflammation or obstruction of the eustachian tubes; syphilis: and atony, or paralysis of the auditory nerves. When it arises in consequence of organic affection, all our endeavours will generally prove fruitless; but when it arises from obstruction of the eustachian tube, it will be commonly removed by puncturing the membrana tympani: if from too great dryness of the ear, a few drops of a mixture composed of half an ounce of oil of almonds and forty drops of oil of turpentine is recommended. It should be applied to the internal ear by means of a dossil of cotton, taking care to keep the cavity clean, by wiping it daily with a large camel hair pencil. If it arise from hardened wax, the interior cavity must be softened by frequently injecting warm water and soap, or a solution of sea-salt in as much water as will barely dissolve it, which last is an excellent solvent of the wax. The ear may afterwards be cleansed by syringing it with warm water. The wax may also be softened by occasionally insinuating into the ear a few drops of a mixture, composed of three parts of ox-gall and one part of the balsam of Peru. This is also of service when there is a fetid discharge from the ear, or a diseased state of its secretions. When it arises in consequence of inflammation, topical blood-letting, blisters behind the ears, and exclusion of the external air, will be necessary. If the disease proceed from an affection of the eustachian tubes, stimulating gargles and injections will be proper, at the same time powerful errhines may be employed; and where the patient hears better when there is a loud voice, he should stop the mouth and nostrils, and force the air into the tubes by violent efforts of expiration; and if one effort be not sufficient for that purpose he should employ repeated ones. When it is induced by atony, or paralysis, æther, garlic-juice, and other stimulants, should be applied by means of a dossil of cotton; errhines also are of considerable utility, and should be snuffed up the nose two or three times a day. Blisters behind the ears, electricity, and internal stimulants, will likewise prove useful auxiliaries. If the disease arise in consequence of syphilis, we must apply to a full course of the mercury. Whenever deafness is not easily removed by the ordinary means, the application of blisters behind the ears will often be of service.

Enuresis, involuntary flow of urine. The causes are atony, or paralysis, of the sphincter of the bladder; irritation or compression of the vesica urinaria; the latter period of pregnancy; laxation of the vertebræ. If the disease proceed from atony, the perinæum must be frequently bathed with cold water; repeated blisters must be applied to it and to the os sacrum. We should at the same time administer internal tonics and stimulants, as bark, zinc, and some of the preparations of iron, tincture of cantharides, and the cold bath. If it be induced by paralysis, blisters, electricity, and internal stimulants, must be employed; if from irritation, or compression of the bladder, the cause of it must be discovered, and the proper means of removing it be had recourse to; and if it be in consequence of the pressure of the gravid uterus, the patient should be kept as much as possible in a horizontal posture.

Ischuria. Of this disease there are four species; as affecting the kidneys, ureters, bladder, or urethra. The first proceeds from nephritis, calculi, spasm, grumous blood, or pus in the pelvis of the kidneys, paralysis, and sometimes inflammation of the intestines, or mesentery. If the disease arise from the first mentioned cause, which will be readily discovered by a careful attention to the symptoms, it will be removed by the means pointed out when treating of that inflammation: if it be the consequence of calculi, which will be known by the attendant symptoms, which are a frequent desire of making water, often suddenly stopped as it flows in a full stream; heat and pain soon after the evacuation of it; tenesmus; an itchiness of the anus and extremity of the urethra; colic pains; costiveness; nausea; and frequently vomiting, pain and retraction of the testes, and pain or a sense of weight in one or both thighs. Blood-letting will be requisite, in proportion to the violence of the symptoms of excitement. Laxatives will at the same time be necessary, and the antiphlogistic regimen must be strictly adhered to. The irritation will be allayed by the employment of the warm bath, fomentations, opiates, watery, farinaceous, and mucilaginous fluids, turpentine clysters, and stimulating liniments to the region of the kidneys. If it proceed from a spasmodic affection, opium, æther, hyoscymus, and the warm bath, are the proper remedies. When it arises from grumous blood, or pus, contained in the pelvis of the kidneys, we must promote the expulsion of them by the warm bath, diluents, opiates, and emollient laxative clysters. If it proceed from paralysis, internal and external stimulants, electricity, and the remedies recommended in the treatment of paralysis, must be employed; and if from the last mentioned cause, the most powerful means of removing such inflammations must be employed with diligence, and those means are pointed out in another place.

In ischury, from complaint in the bladder, there is a suppression of urine, accompanied with a circumscribed tumour of the hypogastrium, and a sense of distention in it, and an acute or obtuse pain about the neck of the bladder, attended with a frequent inclination to make water.

When the disease arises from the first mentioned cause, it will be removed by blood-letting, laxatives, emollient laxative clysters, opiates, the warm bath, and friction of the hypogastrium, with a strong solution of camphor, in olive oil, and if we do not succeed by those means, we must draw off the urine with the catheter; and in desperate cases have recourse to puncturing the bladder, either above the pubes, or by passing a trocar into it from the rectum. If the disease arise from scirrhus of the prostate glands, mercury, hemlock, sarsaparilla, and sea-bathing, should be recommended. If it be the consequence of paralysis, electricity, tincture of cantharides, and repeated small blisters will be proper. When it proceeds from spasm, opiates must be employed internally and externally; emollient laxative clysters, the warm bath, and a strong solution of the camphor; and if the patient be plethoric, it will be advisable to take away some blood. When the disease is caused by over-distention of the bladder, from the too long retention of the urine, cold substances must be applied to the hypogastric region, and cold water should be afterwards injected into the bladder. If induced by the presence of grumous blood, pus, or mucus, these are to be removed by tepid injections, diluents, and by the other means recommended in the treatment of the first species. If ectopia of the bladder be the occasion of it, we must endeavour to bring the parts into their proper situation by the means adapted to their cause. If it arise from calculi, this will be discovered by there being an uneasy sensation at the orifice of the urethra after making water; sometimes a dull pain at the neck of the bladder, with a frequent desire of emptying the bladder, and the water often passing drop by drop, or the stream being suddenly interrupted; there will be also a considerable mucous sediment, and some degree of tenesmus, and the patient will generally void his urine when in a horizontal position. Under these circumstances, when the pain is considerable, two drachms of turpentine, incorporated with yolk of egg, and mixed with half a pint of gruel, with from sixty to a hundred drops of laudanum, should be injected: costiveness must afterwards be obviated by rhubarb, combined with soap, or with small doses of calomel, or the saline cathartics: the uva ursi should be administered in doses of a scruple, or more, three times a day, and the dissolution of the calculus must be attempted by lithontriptics, as a drachm of the vegetable alkali, dissolved in a pint of water supersaturated with carbonic acid gas, three times a day; Seltzer or soda water may be employed with advantage, or a large spoonful of a mixture composed of half an ounce of the aqua potassæ and six ounces and a half of the aqua calcis, in some mucilaginous liquor, may be given three times a day. When scybalæ in the rectum occasion the disease, injections of warm oil, or the internal employment of oil of almonds or castor, with laxative and emollient clysters, together with dashing the lower extremities with cold water, will generally succeed in promoting their evacuation. If it arise from flatus, we must employ essential oils and antispasmodics. If it be the consequence of an abcess, which will be discovered by the previous throbbing pain and nature of the discharge, after the bursting of the abscess, the frequent use of warm emollient and oily clysters will be necessary; and if it arise in consequence of the pressure of the gravid uterus, the urine must be drawn off by means of the catheter, until after delivery, when the complaint will cease of course.

Herpes, Tetters. This disease will be removed by the exhibition of some of the following remedies; sulphuric acid, tincture of cantharides, or black hellebore, or muriated mercury combined with tartar emetic and opium; Plummer's pill, or a solution of gamboge in spirit of ammonia, may be given; employing at the same time lime water, or the decoction of guaiacum, sarsaparilla, or elder. The parts should be dressed with the unguentum nitratis hydrargyri, or with the sulphuric acid, mixed with eight times its quantity of pork lard; and we should at the same time employ the warm bath. The pulp of cassia moistened with milk, and the cassia saphera of Linnæus, boiled in vinegar, are recommended upon good authority.

Tinea, Scald-head. This contagious eruption affects the whole of the hairy scalp, and is generally most virulent around the edges of the hair, on the back part of the head, often causing, by the acrimony of the discharge, swellings of the lymphatic glands of the neck. The first step necessary to be taken in the removal of this unpleasant complaint will be to shave the head close, after which it should be well fomented, and cloths moistened in a solution of liver of sulphur in lime-water, in the proportion of half an ounce of the former to a pint of the latter, should be constantly applied to the head; or tar-ointment may be employed, and the access of the air should be prevented by means of a bladder, properly fitted to the head; or a solution of sugar of lead, or of green or blue vitriol, may be tried, and the internal remedies recommended in the treatment of herpes should be employed. If we do not succeed by these means, blisters or an issue should be applied on the head or the adjacent parts.

Psora, Itch. This consists of little watery pimples of a contagious nature, which first appear between the fingers and on the wrists; but in process of time spreading over the whole body, except the face, attended with a great degree of itchiness, especially when warm in bed, or exposed to the heat of a fire. This disease will most certainly be cured by the application of sulphur ointment; taking at the same time flour of sulphur. The unguentum calcis hydrargiri albi, or acidi sulphurici, or a solution of oxide of arsenic, or of muriated mercury, will also speedily remove it. The two last remedies should, however, be employed with much caution. A decoction of white hellebore is also a useful remedy. It may likewise be frequently cured by the exhibition of the sulphuric acid, in doses of from thirty to sixty drops, or more, two or three times a day, and to obviate its griping it should be given in some mucilaginous fluid.

MEDIETAS *linguæ*, a jury or inquest impannelled, whereof the one half consists of natives or denizens, the other strangers, and is used in pleas, wherein the one party is a stranger, the other a denizen.

MEDIUM, in logic, the mean or middle term of a syllogism, being an argument, reason, or consideration, for which we affirm or deny any thing: or, it is the cause why the greater extreme is affirmed or denied of the less in the conclusion.

MEDIUM, in arithmetic, or *Arithmetical Medium* or MEAN, called in the schools medium rei, that which is equally distant from each extreme, or which exceeds the lesser extreme as much as it is exceeded by the greater in respect of quantity, not of proportion: thus 9 is a medium between 6 and 12. See PROPORTION.

MEDIUM, *geometrical*, called in the

schools medium personæ, is that where the same ratio is preserved between the first and second, as between the second and third terms, or that which exceeds in the same ratio, or quota of itself, as it is exceeded: thus 6 is a geometrical medium between 4 and 9.

Medium, in philosophy, that space or region through which a body in motion passes to any point: thus æther is supposed to be the medium through which the heavenly bodies move; air, the medium wherein bodies move near the earth; water, the medium wherein fishes live and move; and glass is also a medium of light, as it affords it a free passage. That density or consistence in the parts of the medium, whereby the motion of bodies in it is retarded, is called the resistance of the medium, which, together with the force of gravity, is the cause of the cessation of the motion of projectiles.

Medium, *subtle* or *æthereal*. Sir Isaac Newton makes it probable, that besides the particular ærial medium, wherein we live and breathe, there is another more universal one, which he calls an æthereal medium, vastly more rare, subtile, elastic, and active than air, and by that means, freely permeating the pores and interstices of all other mediums, and diffusing itself through the whole creation; and by the intervention hereof he thinks it is that most of the great phenomena of nature are effected. This medium he seems to have recourse to, as the first and most remote physical spring, and the ultimate of all natural causes. By the vibrations of this medium, he takes heat to be propagated from lucid bodies, and the intenseness of heat increased and preserved in hot bodies, and from them communicated to cold ones. By this medium he takes light to be reflected, inflected, refracted and put alternately in fits of easy reflection and transmission, which effects he elsewhere ascribes to attraction; so that this medium appears the source and cause even of attraction. Again, this medium being much rarer within the heavenly bodies than in the heavenly spaces, and growing denser as it recedes further from them he supposes the cause of the gravitation of these bodies towards each other, and of the parts towards the bodies. Again, from the vibrations of this same medium excited in the bottom of the eye, by the rays of light, and thence propagated through the capillaments of the optic nerves into the sensory, he takes vision to be performed; and so hearing, from the vibrations of this or some other medium excited in the auditory nerves by the tremors of the air, and propagated through the capillaments of the nerves into the muscles; and thus contracting and dilating them.

The elastic force of this medium, he shews must be prodigious. Light moves at the rate of 95,000,000 miles in about eight minutes, yet the vibrations and pulses of this medium, to cause the fits of easy reflection and easy transmission, must be swifter than light, which is 700,000 times swifter than sound The elastic force of this medium therefore in proportion to its density must be above 490,000,000,000 times greater than the elastic force of the air in proportion to its density; the velocities and pulses of the elastic mediums, being in a subduplicate ratio of the elasticities and the rarities of the mediums taken together, and thus may the vibrations of this medium be conceived as the cause of the elasticity of bodies.

MEDULLA. See Anatomy.

MEDUSA, in natural history, a genus of the Vermes Mollusca class and order. Body gelatinous, orbicular, and generally flat underneath; mouth central, beneath. There are forty-four species divided into two sections, *viz*. A. body with ciliate ribs. B. body smooth. The animals of this genus consist of a tender gelatinous mass of different figures, furnished with arms proceeding from the lower surface; the larger species, when touched, cause a slight tingling and redness, and are usually denominated sea-nettles; they are supposed to constitute the chief food of cetaceous fish; and most of them shine with great splendour in the water.

MEERSCHAUM, in mineralogy, a species of the talc genus, is generally of a yellowish white colour; it occurs massive; internally it is dull; it adheres to the tongue, feels greasy, and the specific gravity is 1.6. It is infusible before the blowpipe without addition. The constituent parts are,

Silica	41
Magnesia	18.25
Lime	0.5
Water . . . . . Carbonic acid . .	39.0
	98.75
Loss . . .	1.25
	100.00

It is principally found in Natolia, in Lesser Asia: and the island of Samos; also in Greece, Hungary, and Moravia; in Spain, and in some parts of America.

It is chiefly used for the manufacture of tobacco-pipes. But the Turks use it as a medicine; they cover also the head and eyes of dead bodies with it before burial. It is used in various parts of the Turkish dominions as fuller's earth is used here. It is distinguished from native talc earth by its colours, greater softness, and less specific gravity; from lithomarge, by its colours and specific gravity; and from bole, by its colours, want of lustre, and transparency.

MEESIA, in botany, a genus of the Cryptogamia Musci class and order. Generic character: capsule oblong; peristome double; outer with sixteen short blunt teeth; inner with as many sharp cilias, distinct or connected by net-work: males approaching the females, or discoid, on a different plant.

MELALEUCA, in botany, a genus of the Polyadelphia Polyandria class and order. Natural order of Myrti, Jussieu. Essential character: calyx five-cleft, half superior; petals five; filaments many, very long, in five bodies; style one; capsule three-celled. There are eleven species, of which M. leucadendron, aromatic melaleuca; is a tree with a black trunk and white branches, whence the name melaleuca, leaves quite entire, almost veinless, petioled; fructifications sessile, agglutinated, scattered below the leaves. It is a native of some parts of the East Indies and Cochin China; from it is distilled the green aromatic oil called cajeput, from caya puti, a white tree, which is the Malay name; the oil has the taste of peppermint, and a smell like turpentine; it seldom comes to Europe unadulterated; a decoction of the leaves is much used in Cochin China as a tonic, &c. The bark is very serviceable in caulking boats and covering houses. M. hypericifolia, St. John's wort leaved melaleuca, is the most beautiful of the genus; it is plentiful in the English gardens, and was generally taken for an hypericum, till it produced its elegant flowers, which grow in a cylindrical form round the branches, having some resemblance to those of metrosideros lanceolata, commonly called citrina, occasioned by the radiated crimson filaments projecting in every direction: the claws of those filaments are very long, linear, and of a dull yellowish hue, like the petals. It grows in swampy grounds, in New South Wales.

MELAMPODIUM, in botany, a genus of the Syngenesia Polygamia Necessaria class and order. Natural order of Compositæ Discoideæ. Corymbiferæ, Jussieu. Essential character: calyx five-leaved; receptacle chaffy, conical; down one-leafed, involuted, converging. There are three species, annuals, and natives of South America and the West Indies.

MELAMPYRUM, in botany, *cow-wheat*, a genus of the Didynamia Angiospermia class and order. Natural order of Personatæ. Pediculares, Jussieu. Essential character; calyx four-cleft; corolla upper lip compressed, with the edge folded back; capsule two-celled, oblique, opening on one side; seeds two, gibbous. There are five species, four of them are natives of Britain, growing spontaneously in corn-fields; they are all annuals.

MELANITE, in mineralogy, a species of the flint genus, is of a velvet black colour inclining to greyish black. It occurs crystallized, and also in grains. In figure the crystals are six-sided prisms. Externally it is always smooth and shining, approaching to splendent. Internally it is shining, inclining to glistening. Specific gravity 3.7 to 3.8. It is composed of

Silica	35
Alumina	6
Lime	32
Oxide of iron	25
Manganese	2
	100

It has been found only at Frescati and St. Albano near Rome, in rocks belonging to the newest flœtz trap formation.

MELANTHIUM, in botany, a genus of the Hexandria Trigynia class and order. Natural order of Coronariæ Junci, Jussieu. Essential character: corolla six-petalled: filaments from the enlongated claws of the corolla. There are ten species, of which M. virginicum, Virginian melanthium, has the flower stalks from six to eight inches high, branching at top into three or four divisions, with two or three linear leaves below the flowers; corolla of a dusky colour, rarely succeeded by seeds in England. Native of Virginia and several parts of North America.

MELASTOMA, in botany, a genus of the Decandria Monogynia class and order. Natural order of Calacanthemæ. Melastomæ, Jussieu. Essential character: calyx five-cleft, bell-shaped; petals five, inserted into the calyx; berry five-celled, wrapped up in the calyx. There are sixty-seven species, of which M. acinodendron is a large tree, having many crooked branches, covered with a brown bark, and smooth entire leaves, above five inches long, and two broad in the middle, with three deep veins running through them; both sides are of a light green, the edges are sharply indented, ending in acute points; the fruit grows in loose spikes at the end of the branches, of a violet colour. Native of South America.

MELEAGRIS, in natural history, the *turkey*, a genus of birds of the order Gallinæ. Generic character: bill convex, short and strong; head and neck covered with spongy caruncles; chin with a longitudinal membranaceous caruncle; tail broad and expansile. Gmelin notices two species, and Latham five. The meleagris gallipavo, or wild turkey, is a native of America, the presumed origin of every species under the genus. In the northern parts of that continent these birds are found in flocks even of several hundreds, which, during the day-time, resort to the woods, feeding principally upon acorns, returning by night to some swampy grounds, where they roost upon the highest trees. In Carolina they occasionally grow to the weight of thirty, and even, it is said, forty pounds, and at Surinam, they attain also a very considerable size. They are often taken by means of dogs, which, obliging them to run for a very considerable time, at length nearly exhaust their strength, and force them to take refuge in the tops of the tallest trees. Here, if within reach of the sportsman, they incur inevitable destruction, as the preceding exertions have occasioned so great a lassitude as to preclude all further effort; and they drop one after another, submitting without the slightest resistance to their fate. Turkeys breed only once in a year, but will produce a great number at a time, sometimes even so many as seventeen. The female sits with extreme closeness, and is very assiduous in maternal duties. The young, however, are very susceptible of injury, from almost innumerable causes, from cold and wet, and even sunshine itself, which, when powerful, has often been known to prove fatal to them. They are reared, therefore, in England with great care and difficulty only, but in the counties of Suffolk and Norfolk are nevertheless considered as a profitable appendage to almost every farming establishment. From these counties they are driven to the metropolis at certain seasons, and urged on the road by long sticks with bits of red cloth waving at the end of them, the sight of which excites in these birds uncommon terror. In their expressions of the strongest feelings, both of attachment and antipathy, they raise their train, and spread it nearly into a complete circle, uttering certain hollow and internal sounds, which produce a general agitation throughout the body. Collecting and displaying, in this manner, their whole dignity, they move with a slow and ostentatious step, desirous, as it were, to convince alike the objects of their love and hatred of their possessing superior power and consequence. See Aves, Plate VIII. fig. 8.

MELIA, in botany, *bead-tree*, a genus of the Decandria Monogynia class and order. Natural order of Trihilatæ. Meliæ, Jussieu. Essential character: calyx five-toothed; petals five; nectary cylindric, bearing the anthers at its mouth; drupe with a five-celled nucleus. There are three species, large trees, growing naturally in the East Indies.

MELIANTHUS, in botany, *honey-flower*, a genus of the Didynamia Angiospermia class and order. Natural order of Corydales. Rutaceæ, Jussieu. Essential character: calyx four-leaved, the lower leaf gibbous; petals four, with the nectary within the lowest; capsule five-celled. There are three species, natives of the Cape of Good Hope.

MELICA, in botany, *melic-grass*, a genus of the Triandria Digynia class and order. Natural order of Gramina, Gramineæ or Grasses. Essential character: calyx two-valved, two-flowered, with the rudiment of one or two florets that are abortive between the two others. There are fourteen species.

MELICOCCA, in botany, a genus of the Octandria Monogynia class and order. Natural order of Sapindi, Jussieu. Essential character: calyx four-parted; petals four, bent back below the calyx; stigma subpeltate; drupe or berry coriaceous. There is but one species, *viz.* M. bijuga, a middle sized tree with spreading branches; it is a native of South America, and cultivated both in the East and West Indies; it thrives well in the low lands about Kingston in Jamaica, sometimes rising to the height of eighteen feet or more; the fruit is mellow, growing to the size of a large plum.

MELICOPE, in botany, a genus of the Octandria Monogynia class and order. Essential character: calyx inferior, four-leaved: petals four; nectary glands four, twin; capsule four; one-seeded. There is but one species, *viz.* M. ternata, a native of New Zealand.

MELICYTUS, in botany, a genus of the Dioecia Pentandria class and order. Essential character: calyx five-toothed;

corolla five-petalled, three times as long as the calyx; nectary five scales; male anthers five, without filaments, fastened to the inside of the nectary; female stigma flattened out, four or five lobed; capsule berried, one-celled; seeds nestling. There is but one species, *viz.* M. ramiflorus, a native of New Zealand.

MELISSA, in botany, *baum* or *balm*, a genus of the Didynamia Gymnospermia class and order. Natural order of Verticillatæ. Labiatæ, Jussieu. Essential character: calyx dry, flattish above; upper lip subfastigiate; corolla, upper lip somewhat arched, bifid: lower lip with the middle lobe heart-shaped. There are six species, of which M. officinalis, common garden balm, has a perennial root and an annual stalk, which is square, branching from two to three feet high; leaves by pairs at each joint, two inches and a half long; the flowers grow in loose small bunches from the axils in whorls, upon single peduncles of a white or yellowish colour. Baum or balm is a native of the southern parts of Europe, especially in mountainous situations.

MELITTIS, in botany, *bastard baum*, a genus of the Didynamia Gymnospermia class and order. Natural order of Verticillatæ. Labiatæ, Jussieu. Essential character: calyx wider than the tube of the corolla; corolla, upper lip flat, lower crenated: anthers crosswise. There are two species, *viz.* M. melissophyllum, bastard balm, and M. Japonica; the former has a perennial root, sending up three or four stems about a foot and a half in height; leaves opposite, petioled, elliptic, a little pointed; flowers large and handsome, growing principally on one side; peduncles round, hairy, and axillary: much honey is secreted from a gland that encircles the base of the germ, for which reason it is a favourite plant with bees. Native of several parts of Europe.

MELLITES, in chemistry, a genus of salts formed from the MELLITIC *acid*, which see.

MELLITE, or *honey-stone*, in mineralogy, takes its name from the yellow colour like that of honey. Its primitive figure is an octahedron, formed by four-sided pyramids, the common base of which is a perfect square. The crystals are small, their surface is commonly smooth and shining. Internally it is splendent, with a lustre between, vitreous and resinous. It is transparent, passing into the opaque, and possesses a double refraction. It is softer than amber, and brittle. Specific gravity is from about 1.5 to 1.7. It becomes electric by friction, but continues so but a short time. From some experiments of Klaproth, the constituent parts of mellite are,

Silica	1.375
Iron	0.125
Alumina	14.5
Mellitic acid, water, and loss	84.
	100

This mineral is not often to be met with; hitherto it has been found at Ætern in Thuringia; in the district of Saal; and in Switzerland. It occurs on bituminous wood, and earthy coal, and is commonly accompanied with sulphur.

MELLITIC *acid*, in chemistry, is procured from the substance just described by the following process. The mineral is reduced to powder, and boiled with about 72 times its weight of water; the alumina is precipitated in the form of flakes, and the acid combines with the water. By filtration and evaporation, crystals are deposited, which are the crystals of mellitic acid; they are in the form of fine needles, or in small short prisms with shining faces; they have a slightly acid taste, accompanied with some degree of bitterness. This acid is not very soluble in water; its constituent parts are, carbon, hydrogen, and oxygen. The acid enters into combination with the earths, alkalies and metallic oxides, and forms compounds denominated mellates.

MELOCHIA, in botany, a genus of the Monadelphia Pentandria class and order. Natural order of Columniferæ. Malvaceæ, Jussieu. Essential character: five-styled; capsule five-celled, one-seeded. There are eleven species, of which M. pyramidata, pyramidal melochia, is an elegant little plant, about three feet in height, so slender and weak as generally to require some support; the umbels of flowers are usually placed pretty near, and each has five or six rays on a common peduncle; it is a native of Brazil and Jamaica.

MELODINUS, in botany, a genus of the Pentandria Digynia class and order. Natural order of Contortæ. Apocineæ, Jussieu. Essential character: contorted nectary in the middle of the tube, stellate; berry two-celled, many seeded. There is but one species, *viz.* M. Scandens, a native of New Caledonia.

MELODY, in music, the agreeable effect of different sounds, ranged and disposed in succession; so that melody is the effect of a single voice or instrument, by which it is distinguished from harmony. See MUSIC.

MELOE, in natural history, a genus of insects of the order Coleoptera. Antennæ moniliform; thorax roundish; head inflected, gibbous; shells soft, flexile. Thirty-five species have been enumerated and described: these are separated into two divisions. A. without wings; shells abbreviated. B. winged; shells as long as the abdomen. The latter division is again divided into those that have horny jaws, bifid; and those with a linear jaw, entire. Of the species we may notice M. proscarabœus, or oil-beetle, which is entirely blue-black or dark violet; it is found in the advanced state of spring in fields and pastures, creeping slowly, the body appearing so distended with eggs, as to cause the insect to move with difficulty. On being roughly touched it suddenly exudes a yellowish moisture from the pores, of a yellow colour, and of a very penetrating and peculiar smell. The female of this species deposits her eggs in a heap beneath the surface of the ground; from these are hatched the larvæ, which find subsistence by attaching themselves to other insects, and absorbing their juices. M. vesicatorius, blister-fly, or Spanish fly, is, as its name imports, found chiefly in Spain. This is an insect of very great beauty, being entirely of the richest gilded grass-green, with black antennæ. This is the famous cantharides of the shops, the safest and most efficacious blister-plaster.

MELON, in botany, is accounted only a species of cucumber. See CUCUMIS.

MELOTHRIA, in botany, a genus of the Triandria Monogynia class and order. Natural order of Cucurbitaceæ. Essential character: calyx five-cleft; corolla bell-shaped, one-petalled; berry three-celled, many seeded. There is but one species, *viz.* M. pendula, a plant growing wild in the woods in Carolina and Virginia; it creeps upon the ground with slender vines, having angular leaves, resembling those of the melon; the fruit, in the West Indies, grows to the size of a pea of an oval figure, changing black when ripe; the inhabitants pickle them green.

MELYRIS, in natural history, a genus of insects of the order Coleoptera. Antennæ entirely perfoliate; head inflected under the thorax; thorax margined; lip clavate, emarginate; jaw one toothed, pinnate. There are three species, *viz.* the viridis, the niger, and the lineatus.

MEMBER, in architecture, denotes any part of a building; as a frieze, cornice, or the like. This word is also sometimes used for the moulding. See MOULDING.

MEMBRANE, in anatomy, a pliable texture of fibres, interwoven together in the same plane.

MEMECYLON, in botany, a genus of the Octandria Monogynia class and order. Natural order of Calycifloræ. Onagræ, Jussieu. Essential character: calyx superior, with a striated base, and the margin quite entire; corolla one-petalled; anthers inserted into the side of the apex of the filament; berry crowned with a cylindrical calyx. There are four species, natives of warm climates.

MEMORY, a faculty of the human mind, whereby it retains or keeps the ideas it has once perceived.

Memory, says Mr. Locke, is, as it were, the store-house of our ideas; for the narrow mind of man not being capable of having many ideas under view at once, it was necessary to have a repository, in which to lay up those ideas which it may afterwards have use for. But our ideas being nothing but actual perceptions in the mind, which cease to be any thing when there is no perception of them, this laying up our ideas in the repository of the memory signifies no more than this; that the mind has a power, in many cases, to revive perceptions it has once had, with this additional perception annexed to them, that it has had them before. And it is by the assistance of this faculty, that we are said to have all those ideas in our understandings which we can bring in sight, and make the objects of our thoughts, without the help of those sensible qualities which first imprinted them there.

Attention and repetition help much to the fixing ideas in our memories: but those which make the deepest and most lasting impressions are those, which are accompanied with pleasure and pain. Ideas but once taken in and never again repeated, are soon lost; as those of colours in such as lost their sight when very young.

The memory of some men is tenacious almost to a miracle: but yet there seems to be a constant decay of all our ideas, even of those which are struck deepest, and in minds the most retentive; so that if they be not sometimes renewed, the print wears out, and at last there remains nothing to be seen.

Those ideas that are often refreshed by

a frequent return of the objects or actions that produce them, fix themselves best in the memory, and remain longest there: such are the original qualities of bodies, *viz.* solidity, extension, figure, motion, &c. and those that almost constantly affect us, as heat and cold.

In memory, the mind is oftentimes more than barely passive; for it often sets itself on work to search some hidden ideas; sometimes they start of their own accord; and sometimes tempestuous passions tumble them out of their cells. This faculty other animals seem to have to a great degree, as well as men, as appears by birds learning of tunes, and their endeavour to hit the notes right. For it seems impossible that they should endeavour to conform their voices (as it is plain they do) to notes whereof they have no idea.

Memory, *local*, among orators, is nothing but the associating the different heads to be handled with the objects before the speaker's eye; so that by only looking around him, he is put in mind of what he is to say.

Memory, *artificial*, *Memoria Technica*, a method of assisting the memory, by forming certain words, the letters of which shall signify the date or æra to be remembered. In order to this, the following series of vowels, diphthongs, and consonants, together with their corresponding numbers, must be exactly learned; so as to be able at pleasure to form a technical word, that shall stand for any number, or to resolve such a word already formed.

a	*e*	*i*	*o*	*u*	*au*	*oi*	*ei*	*on*	*y*
1	2	3	4	5	6	7	8	9	0
b	*d*	*t*	*f*	*l*	*s*	*p*	*k*	*n*	*z*

The first five vowels, in order, naturally represent 1, 2, 3, 4, 5; the diphthong *au* = 6, as being composed of *a* and *u*, or 1 + 5 = 6; and for the like reason, *oi* = 7, and *ou* = 9. The diphthong *ei* will easily be remembered for 8, as being the initials of the word. In like manner, where the initial consonants could conveniently be retained, they are made use of to signify the number, as *t* for 3, *f* for 4, *s* for 6, and *n* for 9. The rest were assigned without any particular reason, unless that possibly *p* may be more easily remembered for 7, or septem; *k* for 8, or οκτω; *d* for 2, or duo; *b* for 1, as being the first consonant; and *l* for 5, being the Roman letter for 50; than any others that could have been put in their places.

It is further to be observed, that *z* and *y* being made use of to represent the cypher, where many cyphers meet together, as 1,000, 1,000,000, &c. instead of a repetition of *a z y z y z y*, &c. let *g* stand for 100, *th* for a thousand, and *m* for a million. Thus *ag* will be 100, *ig* 300, *oug* 900, &c.; *ath* 1,000, *am* 1,000,000, *loum* 59,000,000, &c.

Fractions may be set down in the following manner; let *r* signify the line separating the numerator and denominator, the first coming *before*, the other *after* it; as *iro* $\frac{3}{4}$, *urp* $\frac{5}{7}$, *pourag* $\frac{79}{100}$, &c. When the numerator is 1, or unit, it need not be expressed, but begin the fraction with *r*; as *re* $\frac{1}{2}$, *ri* $\frac{1}{3}$, *ro* $\frac{1}{4}$, &c. So in decimals, *rag* $\frac{1}{100}$, *rath* $\frac{1}{1000}$.

This is the principal part of the method which consists in expressing numbers by artificial words. The application to history and chronology is also performed by artificial words. The art herein consists in making such a change in the ending of the name of a place, person, planet, coin, &c. without altering the beginning of it, as shall readily suggest the thing sought, at the same time that the beginning of the word, being preserved, shall be a leading or prompting syllable to the ending of it so changed. Thus, in order to remember the years in which Cyrus, Alexander, and Julius Cæsar, founded their respective monarchies, the following words may be formed; for Cyrus, Cyr*uts*; for Alexander, Alex*ita*; for Julius Cæsar, Juli*os*. *Uts* signifies, according to the powers assigned to the letters before mentioned, 536; *ita* is 331, and *os* is 46. Hence it will be easy to remember, that the empire of Cyrus was founded 536 years before Christ, that of Alexander, 331, and that of Julius Cæsar, 46. This account is taken from a treatise entitled "A New Method of Artificial Memory;" where the reader will find several examples in chronology, geography, &c. of such artificial words disposed in verses, which must be allowed to contribute much to the assistance of the memory, since, being once learned, they are seldom or never forgot. However, the author advises his reader to form the words and verses himself, in the manner described above, as he will probably remember these better than those formed by another.

Be this as it will, we shall here give his table of the kings of England since the

Conquest; where one thousand being added to the italics in each word, expresses the year when they began their reigns. Thus

Wil-con*sau*, Ruf*kei*, Hen-*rag*.
Steph*bil* & Hensec*buf*, Rich*bein*, J*ann*, Heth*das*, & Ed*doid*.
Edse*typ*, Edter*tes*, Rise*toip*, Hefo*toun*, Hefi*fad*que.
Hensi*fed*, Edquar*fauz*, Efi Ro*kt*, Hensep*feil*, Henoc*lyn*.
Edsex*los*, Mary*lut*, Els*luk*, Jams*yd*, Caroprim*sel*.
Carsec*sok*, Jam*seif*, Wil*seik*, An*pyb*, Geo*bo-doi-sy*.

MENACHINITE, in mineralogy, a species of the Titanium genus, is of a greyish black colour, inclining to iron-black; it occurs only in very small flattish angular grains, which have a rough, glimmering surface; internally it is glistening; specific gravity 4.2 to 4.5. It is attractable by the magnet, but in a much weaker degree than iron sand, or magnetic ironstone. Without addition, it is infusible before the blow-pipe; it tinges borax of a greenish colour, which inclines to brown: according to Klaproth, the constituent parts are

Magnetic oxide of iron	51
Oxide of menachine	45.25
Oxide of manganese	0.25
Silica	3.50
	100.00

This mineral is found accompanied by fine quartz sand, in the bed of a rivulet which enters the valley of Manachan in Cornwall; also on the shores of the island of Providence in America; and at Botany Bay: it is distinguished from ironsand by the fracture, lustre, and inferior hardness.

MENAIS, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Borragineæ, Jussieu. Essential character: calyx three-leaved; corolla salver-shaped; berry four-celled; seeds solitary. There is but one species, *viz.* M. topiaria, a native of South America.

MENILITE, in mineralogy, is of a chesnut-brown colour, inclining to liver-brown: externally, it is marked with narrow stripes of reddish brown and pearl-grey, which alternate with each other. It occurs in tuberose imbedded masses, the surface of which is smooth and ribbed, and sometimes covered with a white crust. It is found in adhesive slate, at Menil Montagne, near Paris: the constituents are,

Silica	85.50
Alumina	1.
Oxide of iron	0.50
Calcareous earth	0.50
Water and carbonaceous matter	11.00
	98.50
Loss	1.5
	100

MENISCIUM, in botany, a genus of the Cryptogamia Filices, or Ferns. Generic character: capsules heaped in crescents, interposed between the veins of the frond. There is but one species, *viz.* M. reticulatum, a native of Martinico, Brazil, &c.

MENISCUS, in optics, a lens, convex on one side and concave on the other. See Lens. For finding the focus of a meniscus, the rule is: as the difference of the semidiameters of the concavity and convexity is to the semidiameter of the concavity, so is the diameter of the convexity to the focal distance.

MENISPERMUM, in botany, *moonseed*, a genus of the Dioecia Dodecandria class and order. Natural order of Sarmentaceæ. Mensiperma, Jussieu. Essential character: male petals, four outer; eight inner; stamina sixteen: female, corolla as in the male; stamina eight, barren; berries two, one-seeded. There are thirteen species.

MENSURATION is the art of ascertaining the contents of superficial areas, or planes; of solids, or substantial objects; and the lengths, breadths, &c. of various figures; either collectively or abstractedly. The mensuration of a plane superficies, or surface, lying level between its several boundaries, is easy: when the figure is regular, such as a square, or a parallelogram, the height, multiplied by the breadth, will give the superficial contents. Thus, if a table be 5 feet 2 inches in length, by 4 feet 1 inch in breadth, multiply 62, (the number of inches in 5 feet 2 inches) by 49, (the number of inches in 4 feet 1 inch,) the result will shew the number of square inches; which, being divided by 144, (the number of square inches in a square foot,) will exhibit the number of square feet on the surface of the table. Whatever balance may remain, may either be left as fractional, or hundred and forty-fourth parts; or, being divided by 36, may be made to show the numbers of quarters of square feet, beyond the integers produced by the first division.

For instance, multiply 62 inches
by 49 inches

558
248 *f*

Divide by 144)3038)21 : $\frac{14}{144}$
288

158
144

14

In regard to triangles, their bases multiplied by half their heights, or their heights by half their bases, will give the superficial measure. But it is necessary to caution our readers not to measure by the oblique line of a triangle, considering it as the altitude: a reference to the article Geometry will show, that the height of a triangle is taken by means of a perpendicular to the base, limited by a parallel to the latter, which exactly includes the apex, or summit.

Any rectangular figure may have its surface estimated, however numerous the sides may be, simply dividing it into triangles, by drawing lines from one angle to another, but taking care that no cross lines be made: thus, if a triangle should be equally subdivided, it may be done by one line, which must, however, be drawn from any one point to the centre of the opposite face. A four-sided figure will be divided into two triangles, by one oblique line connecting the two opposite angles: a five-sided figure (or pentagon) by two lines, cutting as it were one triangle out of the middle, and making one on each side: a six-sided figure (or hexagon) will require three diagonals, which will make four triangles: and so on to any extent, and however long, or short, the several sides may be respectively.

With respect to the form and properties of various figures, we refer our readers to the head of Geometry, where all that relates thereto is pointed out, and the commutations they undergo, when their contents or areas are measured, will be distinctly seen.

The most essential figure is the circle, of which mathematicians conceive it impossible to ascertain the area with perfect precision, except by the aid of logarithmic and algebraic demonstration. It may be sufficient in this place to state, that $8\frac{10}{17}$ of the diameter will give the side of a square, whose area will be correspondent with that of a circle having 10 for its diameter. Therefore, as the diameter may be easily divided, either arithmetically, or mechanically, into ten equal parts, and one of those parts into seventeen, by taking 8 integers, and 10 of the 17th portions, the side of such a square may be easily demonstrated. Where a circle is small, its scale may be extended by an oblique line, which may be made to any extent, as shewn in the fig. 7, Plate X. Miscel. where A B is the diameter of a circle, and A C the oblique line, lying between the perpendiculars that would fall on A B. If A C be divided into any number of parts, perpendiculars drawn from A B to the points of division, as *a b*, *c d*, will divide the diameter exactly, in the same proportions as A C is divided. The radius, or semidiameter of a circle, also gives us the means of forming a square corresponding with its area. Having drawn the whole diameter, A B, fig. 8, take the radius, C B, and set it off from B to D; from which measure another radius, at right angles with C B, to wherever it may fall, *i e*, at E, on the diameter: the hypothenuse, B E, will give the side of the square sought.

We have been particular in describing this process, because so many circular or cylindrical figures come under the measurer's consideration, whether they be mirrors, arched passages, columns, &c. The contents of a pillar are easily ascertained, even though its diameter may be perpetually varying; for if we take the diameter in different parts, and strike a mean between every two adjoined measurements, and multiply that mean area by the depth, or interval between the two, the solid contents will be found.

The contents of pyramids are measured by multiplying the areas of their bases by half their lengths: or their lengths by half the areas of their bases. Cones, whose sides are straight, are equal to one-third the solid contents of cylinders, equal to them in base and altitude.

Solids, which have a certain degree of regularity, may be easily measured: thus a cube is computed by multiplying first its width by its length; then their sum by its height: thus a cube, measuring four feet each way, would be $4 \times 4 = 16 \times 4 =$

64. This is the meaning of what is called the cube root: see CUBIC NUMBER. Parallelopipedons, or solids of a long form, such as squared timbers, are measured by the same means: say that a timber be seven feet long, and at its ends be six inches by four. The area of either end, which is here considered as the base, will give 24 squares inches, which multiplied by 84 (the number of inches in 7 feet) will show 2,016 solid inches. Divide by 1728, (the number of solid inches in a solid foot), and the result will be 1 foot 288 solid inches. But we have a shorter way, when, as in the above instance, the parts are regular multiples; for 6 by 4 is the sixth part of a superficial foot; consequently six feet in length of such a beam answers to one foot cube, and the remainder will shew the sixth part of a foot cube; so that we may indicate the amount, either as above, or by calling it one solid foot and one-sixth. For the mensuration of growing timber, various modes have been offered; but we know of none more simple than that invented by Captain Williamson, and exemplified in his "Mathematics Simplified."

His practice has been to fix a short batten, at exactly 45 degrees, angular with a staff of about 5½ feet long; the latter being armed with a spike to fix it in the soil, and having a plumb line at one corner. When a sight taken along the batten, (the staff being exactly perpendicular,) points to the highest part of a tree, that is of the main trunk, measure the distance from the place where the staff is fixed to the place where the tree stands: the intermediate distance, added to the length of the staff, will shew the height to which the timber is marketable. For it is evident, that as an angle of 45 degrees gives equal base and perpendicular, so must the altitude correspondent with the distance between the junction of the batten with the staff to the tree, and a perpendicular from the part cut on the tree, by the line of sight, to the level of that junction, the length of the staff must correspond with the length of stem below that level. We beg leave to refer our readers to the publication above quoted for further particulars on this head, as well as for numerous useful hints in regard to surveying in general. See fig. 9.

After a tree has been felled, its girth is usually taken at each end, and at the middle, when there is no particular swell, or that the top extremity does not suddenly decrease. This rule may answer well; but where the irregularity is great, it is better to take many more girths, and summing up the whole, to divide their amount by the number of girths taken, so as to establish a mean measurement. Divide that mean measurement by 4, to find the side of a square to which the tree will be reduced when prepared for the sawyer. If the whole solid contents are to be estimated, divide by 3, instead of by 4, and taking the third part, thus given, for a diameter, act upon it as already shewn, to find the side of a square, equal to the circle of which that ascertained third part is the diameter.

The greatest portion of mensuration appertains to the contents of solid bodies, or areas, such as hay-stacks, interiors of barns, granaries, &c.; all of which come under the rule laid down for cubes, &c. When any sides fall in regularly, as in garrets, &c. the inclined part must be treated as a pyramid, or as a quoin, (or wedge), and the whole be summed up together. The contents of casks, tubs, &c. are treated of under the head of GAUGING, (which see), and that part of our subject which appertains to the admeasurement of lands, as also to the distances, heights, &c. of remote objects, accessible or otherwise, will be found under the head of SURVEYING.

MENTHA, in botany, *mint*, a genus of the Didynamia Gymnospermia class and order. Natural order of Verticillatæ or Labiatæ. Essential character: corolla almost equal, four-cleft, the broader segment emarginate; stamina upright, distant. There are nineteen species. M. viridis, spearmint, possesses a more agreeable flavour than most of the others: it is generally preferred for culinary, and some medicinal purposes; this herb contains a good deal of essential oil, as do all the other mints; but of a much less agreeable odour than that of lavender or marjoram. It is a native of several parts of Europe.

MENTZELIA, in botany, so named from Christian Mentzelius, Physician to the Elector of Brandenburgh, a genus of the Polyandria Monogynia class and order. Natural order of Calycanthemæ. Onagræ, Jussieu. Essential character: calyx five-leaved; corolla five-petalled; capsule inforior, cylindric, many-seeded. There is but one species, *viz.* M. aspera, an annual plant, native of America.

MENYANTHES, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Preciæ. Lysimachiæ, Jussieu. Essential character: corolla shaggy; stigma bifid; capsule one-celled. There are five species, of which M. nymphoides, fringed buckbean, or water-lily, has a long, stringy, perennial root, the stems are round, smooth and jointed, producing opposite thick leaves, floating on the surface of the water, on foot-stalks various in length, according to the depth of the stream; the flowers grow from the axils in a kind of sessile umbel, four or five together, on long round peduncles, shorter than the petioles; when expanded in the sun they have a brilliant appearance. It is a native of Denmark, Holland, Germany, Piedmont, and England, growing in ditches and slow streams; it flowers from June to August.

MERCHANT, a person who buys and sells commodities in gross, or deals in exchanges; or that traffics in the way of commerce, either by importation or exportation. Formerly, every one who was a buyer or seller in the retail way was called a merchant, as they are still both in France and Holland; but here, shopkeepers, or those who attend fairs or markets, have lost that appellation.

Previously to a person's engaging in a general trade, and becoming an universal dealer, he ought to treasure up such a fund of useful knowledge, as will enable him to carry it on with ease to himself, and without risking such losses as great, ill-concerted undertakings would naturally expose him to. A merchant should therefore be acquainted with the following parts of commercial learning: 1. He should write properly and correctly. 2. Understand all the rules of Arithmetic that have any relation to commerce. 3. Know how to keep books of double and single entry, as journals, a ledger, &c. 4. Be expert in the forms of invoices, accounts of sales, policies of insurance, charter-parties, bills of lading, and bills of exchange. 5. Know the agreement between the money, weights and measures of all parts. 6. If he deals in silk, woollen, linen, or hair manufactures, he ought to know the places where the different sorts of merchandizes are manufactured, in what manner they are made, what are the materials of which they are composed, and from whence they come, the preparations of these materials before working up, and the places to which they are sent after their fabrication. 7. He ought to know the lengths and breadths which silk, woollen, or hair-stuffs, linen, cottons, fustians, &c. ought to have, according to the several statutes and regulations of the places where they are manufactured, with their different prices, according to the times and seasons; and if he can add to his knowledge the different dyes and ingredients which form the various colours, it will not be useless. 8. If he confines his trade to that of oils, wines, &c. he ought to inform himself particularly of the appearances of the succeeding crops, in order to regulate his disposing of what he has on hand; and to learn as exactly as he can, what they have produced when got in, for his direction in making the necessary purchases and engagements. 9. He ought to be acquainted with the sorts of merchandize found more in one country than another, those which are scarce, their different species and qualities, and the properest method for bringing them to a good market, either by land or sea. 10. To know which are the merchandizes permitted or prohibited, as well on entering as going out of the kingdoms or states where they are made. 11. To be acquainted with the price of exchange, according to the course of different places, and what is the cause of its rise and fall. 12. To know the customs due on importation or exportation of merchandizes, according to the usage, the tarifs, and regulations of the places to which he trades. 13. To know the best manner of folding up, embaling, or turning the merchandizes, for their preservation. 14. To understand the price and condition of freighting and insuring ships and merchandize. 15. To be acquainted with the goodness and value of all necessaries for the construction and repairs of shipping, the different manner of their building, what the wood, the masts, cordage, cannons, sails, and all requisites, may cost. 16. To know the wages commonly given to the captains, officers, and sailors, and the manner of engaging with them. 17. He ought to understand the foreign languages, or at least as many of them as he can attain to; these may be reduced to four, *viz.* the Spanish, which is used not only in Spain, but on the coast of Africa, from the Canaries to the Cape of Good Hope; the Italian, which is understood on all the coasts of the Mediterranean, and in many parts of the Levant; the German, which is understood in almost all the northern countries; and the French, which is now become almost universally current. 18. He ought to be acquainted with the consular jurisdiction, with the laws, customs, and usages, of the different countries he does or may trade to; and in general all the ordinances and regulations, both at home and abroad, that have any relation to commerce. 19. Though it is not necessary for a merchant to be very learned, it is proper that he should know something of history, particularly that of his own country, geography, hydrography, or the science of navigation, and that he is acquainted with the discoveries of the countries in which trade is established, in what manner it is settled, of the companies formed to support those establishments, and of the colonies they have sent out.

All these branches of knowledge are of great service to a merchant who carries on an extensive commerce; but if his trade and his views are more limited, his learning and knowledge may be so too: but a material requisite for forming a merchant is his having on all occasions a strict regard to truth, and his avoiding fraud and deceit, as corroding cankers that must inevitably destroy his reputation and fortune.

Trade is a thing of so universal a nature, that it is impossible for the laws of England, or of any other nation, to determine all the affairs relating to it; therefore all nations, as well as Great Britain, shew a particular regard to the law merchant, which is a law made by the merchants among themselves: however, merchants and other strangers are subject to the laws of the country in which they reside. Foreign merchants are to sell their merchandize at the port where they land, in gross, and not by retail; and they are allowed to be paid in gold or silver bullion, in foreign coin or jewels, which may be exported. If a difference arises between the King and any foreign state, the merchants of that state are allowed six months time to sell their effects and leave the kingdom, during which time they are to remain free and unmolested in their persons and goods.

Merchant. The law of merchants is part of the common law of England. See Insurance, Bills of Exchange.

MERCURIALIS, in botany, *mercury*, a genus of the Dioecia Enneandria class and order. Natural order of Tricoccæ. Ephorbiæ, Jussieu. Essential character: male, calyx three-parted; corolla none; stamina nine or twelve; anthers globular, twin: female, calyx three-parted; corolla none; styles two; capsule dicoccous, two-celled, one-seeded. There are six species

MERCURY, a metal which has long been distinguished, as the only one that retains its fluidity at the common temperature of the atmosphere. The late discoveries of Mr. Davy have, however, produced two others which possess this property: these will be noticed in their places: see Sodium, and Potassium; see also Alkali. When the temperature is reduced to about 40° below zero of Fahrenheit, it assumes a solid form: this however is a degree of cold that never occurs but in high northern latitudes, and in this country mercury can only be exhibited in a solid state by artificial means: see Cold. When congealed, its specific gravity is so much increased, that it sinks to the bottom of the fluid mass. It has been increased from 13.5 to 15.6. At about 600° of Fahrenheit, it boils and is changed into vapour, and this method is taken to purify it from the admixture of other metals. When very pure, mercury is not oxydized at the common temperature of the atmosphere, but may be converted into an oxide by boiling. It is dissolved by hot sulphuric acid, and forms a white salt, which, being washed with boiling water, produces a yellow substance called turbith mineral. It may likewise be dissolved by nitric acid with and without heat; but the mercury is more highly charged with oxygen in the former case than in the latter. It may be united to the muriatic acid by a double elective affinity: thus when sulphate of mercury and muriate of soda, both dry, are mixed and exposed to heat, a combination of oxide of mercury and muriatic acid is obtained by sublimation: this is called in the shops "corrosive sublimate." "Calomel" is compounded of the same substances, but with a larger proportion of mercury. Corrosive muriate of mercury is in the form of a white compact mass, tending to a crystalline arrangement: it is soluble in about twenty parts of water, at the temperature of 60°, and in two parts of boiling water. In alcohol much larger portions are dissolved. The taste of this salt is styptic and disagreeable, and it acts as a most virulent poison, so that although it is used in medicine, it cannot be administered in larger quantities than the sixth or eighth of a grain. The oxide which exists in the corrosive muriate of mercury consists of

Mercury	85
Oxygen	15
	100

In the muriate there are

Oxide	82
Acid	18
	100

Therefore 100 parts of the muriate consist of

Mercury	67
Oxygen	12.3

forming eighty-two parts of oxide, with which eighteen parts of muriatic acid are combined.

The oxides of mercury are all reduced by heat alone, without the addition of any combustible substance, and afford oxygen gas. Mercury itself dissolves gold, silver, tin, and other metals, and if properly combined with it in sufficient quantity, the mercury loses its fluidity, and forms an amalgam. It is observed, that a solid amalgam of lead, and another of bismuth, have the property of becoming fluid. By combination with sulphur mercury affords two compounds. By long trituration, these bodies unite, and form a black sulphuret. When united by fusion, and afterwards sublimed, a red sulphuret is produced, called cinnabar, which, being reduced to powder, affords the common pigment vermilion.

Mercury is the basis of a new fulminating compound. The oxides precipitated from their combinations with acids, by the alkalies or earths, especially by ammonia or lime, are capable, when combined with sulphur, of detonating. If triturated with one-sixth part of their weight of sulphur, on being exposed gradually to heat they explode with considerable force. These materials must be prepared and dried in the open air, and exposed to the light. Mr. Howard has discovered another fulminating powder of mercury, possessed of still greater powers. This is prepared by dissolving 100 grains of mercury in one ounce and a half of nitric acid: the solution, when cold, is to be poured upon two ounces of alcohol: a moderate heat is then to be applied, till an effervescence is excited, when a precipitate is formed, which is to be immediately collected on a filter, well washed with distilled water, and carefully dried in a heat not much exceeding that of a water-bath. From 100 grains of mercury, between 120 and 130 grains of dry precipitate are formed. This preparation fulminates very strongly. If two or three grains only be laid on an anvil, and struck smartly with a hammer, it explodes with a loud report. Four grains will occasion indentation in the hammer and anvil. This powder is found to consist of oxide of mercury, combined with oxalic acid and nitrous etherized gas: the two latter being produced during its formation, by the action of the nitric acid on the alcohol. Its explosion and force are supposed to be owing to the oxygen present suddenly combining with the carbon and hydrogen, forming watery vapour and carbonic acid: azotic gas is also discharged, and much caloric is evolved, so as to volatilize the mercury: to this, the conversion of the mercury into vapour, Mr. Howard ascribes its great explosive velocity.

We have observed that mercury unites with many of the metals: from this property it is used to separate gold and silver from the substances with which they are mixed. It is thus capable of extracting the hundred-thousandth part of its weight of gold. In gilding and silvering, it is, from the same property, the medium of union between the gold or silver, and the metal on which the operation is performed. Hence mercury is of extensive use in the arts: its amalgam with tin is used in silvering mirrors, and in electrical experiments. Its importance in the structure of the common barometer is well known: and the uniformity of its expansion, at various degrees of heat, has shewn it to be the best fluid for thermometers.

Mercury, in astronomy, is a small star that emits a very bright white light: though, by reason of his always keeping near the sun, he is seldom to be seen; and when he does make his appearance, his motion towards the sun is so swift, that he can only be discerned for a short time. He appears a little after sunset, and again a little before sunrise. Mercury never goes to a greater distance from the sun than about 27° 5′; so that he is never longer in setting after the sun than an hour and fifty minutes; nor does he ever rise sooner than an hour and fifty minutes before that luminary. Very frequently, he goes so near the sun as to be lost altogether in his rays. When he begins to make his appearance in the evening after sunset, he can scarcely at first be distinguished in the rays of the twilight. But the planet disengages itself more and more, and is seen at a greater distance from the sun every successive evening; and having got to the distance of about 22° 5′, it begins to return again. During this interval, the motion of Mercury, referred to the stars, is direct; but when it approaches within 18° of the sun, it appears for some time stationary; and then its motion begins to be retrograde. The planet continues to approach the sun, and at last plunges into his rays in the evening, and disappears. Soon after it may be perceived in the morning, before sunrise, separating further and further from the sun, his motion being retrograde as before he disappeared. At the distance of 18° it becomes stationary, and assumes a direct motion, continuing, however, to separate, till it comes to 22° 5′ of distance: then it returns again to the sun, plunges into his rays, and appears soon after in the evening, after sunset, to repeat the same career. The angular distance from the sun, which the planet reaches on both sides of that luminary, varies from 16° to nearly 28°. The duration of a complete oscillation, or the interval of time that elapses before the planet returns again to the point from which it set out, varies also from 100 to 130 days. The mean arc of his retrogradation is about 13½°; its mean duration twenty-three days; but the quantity differs greatly in different retrogradations. In general, the laws of the movements of Mercury are very complicated; he does not move exactly in the plane of the ecliptic; sometimes he deviates from it more than 5°. Some considerable time must have elapsed, before astronomers suspected that the stars which were seen approaching the sun in the evening and in the morning were one and the same. The circumstance, however, of the one never being seen at the same time with the other, would gradually lead them to the right conclusion. The apparent diameter of Mercury varies as well as that of the sun and moon, and this variation is obviously connected with his position relatively to the sun, and with the direction of his movement. The diameter is as its minimum when the planet plunges into the solar rays in the morning, or when it disengages itself from them: it is at its maximum when the planet plunges into the solar rays in the evening, or when it disengages itself from them in the evening: that is to say, when the planet passes the sun in its retrograde motion, its diameter is the greatest possible; when it passes the sun in its direct motion, it is the smallest possible; and the mean length of the apparent diameter of Mercury is 11″. Sometimes when the planet disappears during its retrograde motion, that is to say, when it plunges into the sun's rays in the evening, it may be seen crossing the sun under the form of a black spot, which describes a chord along the disk of the sun. This black spot is recognized to be the planet, by its position, its apparent diameter, and its retrograde motion. These transits of Mercury, as they are termed, are real annular eclipses of the sun: they demonstrate that the planet is an opaque body, and that it borrows its light from the sun. When examined by means of telescopes, magnifying about 200 or 300 times, he appears equally luminous throughout his whole surface, without the least dark spot. But he exhibits the same difference of phases with the moon, being sometimes horned, sometimes gibbous, and sometimes shining almost with a round face, though not entirely full, because his enlightened side is never turned directly towards us; but at all times perfectly well defined, without any ragged edge, and perfectly bright. Like the moon, the crescent is always turned towards the sun. These different phases throw considerable light on the orbit of Mercury. See Venus.

Mercury, in heraldry, a term used, in blazoning by planets, for the purple colour in the arms of sovereign princes. See Blazoning.

MERGER, in law, is where a less estate in lands, &c. is drowned in the greater; as if the fee come to the tenant for years or life, the particular estates are merged in the fee: but an estate tail cannot be merged in an estate in fee; for no estate in tail can be extinct by the accession of a greater estate to it.

MERGUS, in natural history, the *Merganser*, a genus of birds of the order Anseres. Generic character: bill serrated, slender, and hooked at the point; nostrils small, oval, and near the middle of the bill; feet four-toed, the outer one before longer than the middle one. There are ten species, of which we shall notice the following. M. merganser, the goosander, weighs about four pounds, and is twenty-eight inches long. It is common in the northern regions of Europe and Asia, and is found in the Orknies during the whole year. It builds sometimes on trees, but generally in the holes and fissures of rocks, and feeds on fish. Its flesh is strong, and seldom applied for food. See Aves, Plate IX. fig. 5. The M. serrater, or red-breasted goosander, is considerably less than the former, is found also in the same latitudes, and breeds in the north of Scotland, particularly in Loch Mari, in the county of Ross. It dives excellently, and is extremely alert on the water. About the season of its moulting, however, the natives of Greenland often kill it by darts, as the birds are less active than usual in that state of weakness, and suffer the enemy to approach more nearly than at other times. These birds, like the former, and indeed the other species of the genus, subsist in a great degree on fish. They fly near the surface of the water, with great apparent vigour, though seldom to any great distance. Their sharp, serrated, and hooked bills are admirably adapted to secure their prey, which is scarcely ever observed, notwithstanding all its lubricity, to elude their grasp. See Aves, Plate IX. fig. 4 For the Smew, see Aves, Plate IX. fig. 6.

MERIDIAN, in astronomy, a great circle passing through the poles of the world, and both the zenith and nadir, crosses the equinoctial at right angles, and divides the sphere into two hemispheres, the eastern and western; it has its poles in the east and west points of the horizon. It is called meridian, because, when the sun cometh to the south part of this circle, it is then mid-day; and then the sun has his greatest altitude for that day. These meridians are various, and change according to the longitudes of places; so that they may be said to be infinite in number, for all places from east to west have their several meridians: but there is (or should be) one fixed, which is called the first meridian. Ptolemy chose to make that the first meridian which passes near the Fortunate islands, at about the distance of one degree from them; and reckons from thence to the east through Africa and Asia; choosing to begin at a place inhabited, and which was then the bounds and limits of the known part of the earth to the west, and to the end at the eastern shore of Scain in Asia; but America being discovered not many ages ago, and long after Ptolemy's time, the first meridian was removed more to the west. Some made that the first meridian which passes through the isle of St. Nicholas, which is one of those near Cape Verd; and Hondius chose the isle of St. James to be the first in his map.

Others chose that which passes through the isle del Corvo, one of the Azores, because the needle was found not to decline from the north there and in the adjacent seas, but to lie in the meridian line; and this beginning Mercator chooses. But seeing there are other places where the needle points to the north, and it doth not so in every part of that meridian, geographers thought this not a sufficient reason; some fixing it at the shore of Brasil, that runs out into the sea. Later geographers choose to begin at the mountain Teneriffe, in the Fortunate or Canary islands, which is counted one of the highest on the earth; and the rather, because they thought some remarkable place should be chosen, that might be most known to future ages: and so Ptolemy's first meridian, though long observed, was not laid aside without good reason. The French, since the year 1634, have taken that which goes through the west part of the isle of Faro, one of the Canaries. Astronomers also have taken divers places for the first meridian; the followers of Tycho fix it at Uraniburg, an island in the Danish streights, and calculate the celestial motions to that place, and from thence accommodate them to the rest. Others choose other places, according to the authors of the ephemeris they use, who calculate the ephemeris, and the planets' places for the meridian of their own place; as Riccioli, who fixed his first meridian at Bologna; Mr. Flamsteed, at the Royal Observatory at Greenwich; and the French, at the Observatory at Paris. See Observatory. But without regard to any of these rules, our geographers and map-makers frequently assume the meridian of the place, or the capital of the country, for the first meridian; and thence reckon the longitudes of their places.

In the Philosophical Transactions, there is a suggestion that the meridians vary in time. This seems very probable, from the old meridian line in the church of St. Petronio at Bologna, which is found to vary no less than eight degrees from the true meridian of that place at this time; and from that of Tycho Brahe at Uraniburg, which M. Picart observes varies eighteen minutes from the modern meridian. If there be any thing of truth in this hint, Dr. Wallis says, the change must arise from a change of the terrestrial poles (here on earth, of the earth's diurnal motion), not of their pointing to this or that of the fixed stars; for if the poles of the diurnal motion remain fixed to the same place on the earth, the meridians which pass through these poles must be the same. But this notion of the changes of the meridian seems overthrown by an observation of M. Chazelles, of the French academy of sciences, who when in Egypt, found that the four sides of a pyramid, built 3000 years ago, still looked very exactly to the four cardinal points; a position which could never be looked on as fortuitous.

The meridian on the globe or sphere is represented by the brazen circle, in which the globe hangs and turns. It is divided into four times 90, or 360°, beginning at the equinoctial. See Globe.

On it, each way from the equinoctial, on the celestial globes, is counted the south and north declination of the sun or stars; and on the terrestrial globes, the latitude of places north or south. There are two points of this circle, which are called the poles of the world; and a diameter continued from thence through the centre of either globe is called the axis of the earth or heavens, on which they are supposed to turn round. On the terrestrial globes there are usually thirty-six meridians drawn, one through every tenth degree of the equator, or through every tenth degree of longitude. The uses of this circle are, 1. To set the globes to any particular latitude. 2. To shew the sun's or a star's declination, right ascension, or greatest altitude, &c.

"To find the sun's meridian altitude or depression at night by the globes." Bring the sun's place to the meridian above the horizon for his altitude at noon, which will shew the degrees of it, counted from the horizon. For his midnight depression below the north point of the horizon, you must bring the opposite point to the sun's present place, as before to the meridian; and the degrees there intercepted between that point and the horizon are his midnight depression.

Meridian line is an arch, or part of the meridian of a place, terminated each way by the horizon. Or it is the intersection of the plane of the meridian of the place with the plane of the horizon, vulgarly called a north and south line, because its direction is from one pole towards the other. It is of great use in astronomy, geography, dialling, &c. and on its exactness all depends; whence divers astronomers have taken infinite pains to have it to the last precision.

Meridian *line*, on a dial, is a right line, arising from the intersection of the meridian of the place with the plane of the dial: this is the line of twelve o'clock, and from hence the division of the hour-lines begin. See Dial.

Meridian, *magnetical*, is a great circle passing through the magnetical poles, to which the magnetic needle, or needle of the mariner's compass, conforms itself.

Meridian *altitude of the sun and stars*, is their altitude when in the meridian of the place where they are observed. Or it may be defined an arch of a great circle perpendicular to the horizon, and comprehended between the horizon and the sun or star then in the meridian of the place.

"To take the meridian altitude with a quadrant." If the position of the meridian be known, and the plane of an astronomical quadrant be placed in the meridian line, by means of the plumb-line suspended at the centre, the meridian altitudes of the stars, which are the principal observations whereon the whole art of astronomy is founded, may easily be determined. The meridian altitude of a star may likewise be had by means of a pendulum-clock, if the exact time of the star's passage over the meridian be known. Now it must be observed, that stars have the same altitude for a minute before and after their passage by their meridian, if they be not in or near the zenith; but if they be, their altitudes must be taken every minute when they are near the meridian, and their greatest altitudes will be the meridian altitudes sought.

MERIDIONAL distance, in navigation, is the same with the departure, easting or westing, or the difference of longitude between the meridian under which the ship now is, and any other meridian she was before under.

Meridional parts, miles, or minutes, in navigation, are the parts by which the meridians in Mr. Wright's chart (commonly though falsely called Mercator's) do increase as the parallels of latitude decrease: and as the cosine of the latitude of any place is equal to the radius or semi-diameter of that parallel, therefore, in the true sea-chart, or nautical plansiphere, this radius being the radius of the equinoctial, or whole sine of 90°, the meridional parts at each degree of latitude must increase, as the secants of the arch, contained between that latitude and the equinoctial, decrease. The tables, therefore, of meridional parts, which we have in books of navigation, are made by a continual addition of secants; they are calculated in some books for every degree and minute of latitude; and they will serve either to make or graduate a Mercator's chart, or to work the Mercator's sailing. To use them, you must enter the table with the degree of latitude at the head, and the minute on the first column towards the left hand, and in the angle of meeting you will have the meridional parts. Having the latitudes of two places, to find the meridional miles or minutes between them, consider whether one of the places lies on the equator, or both on the same side of it, or, lastly, on different sides. 1. If one of the proposed places lies on the equator, then the meridional difference of latitude is the same with the latitude of the other place, taken from the table of meridional parts. 2. If the two proposed places be on the same side of the equator, then the meridional difference of latitude is found, by subtracting the meridional parts answering to the least latitude from those answering to the greatest, and the difference is that required. 3. If the places lie on different sides of the equator, then the meridional difference of latitude, is found by adding together the meridional parts answering to each latitude, and the sum is that required.

MERLON, in fortification, is that part of a parapet which is terminated by two embrasures of a battery. Its height and thickness is the same with that of the parapet; but its breadth is generally nine feet on the inside, and six on the outside. It serves to cover those on the battery from the enemy; and it is better when made of earth, well beat and close, than when built with stone; because they fly about and wound those they should defend.

MEROPS, in natural history, the *bee-eater*, a genus of birds, of the order Picæ. Generic character: bill quadrangular, somewhat curved, compressed and pointed; nostrils small, at the base of the bill; tongue slender, and in some species ciliated; the outer toe somewhat connected with the middle one. Gmelin notices twenty-six species, and Latham twenty. We shall mention only M. apiaster, or the common bee-eater: this is about ten inches long, and found in many countries of Europe, though never observed in Great Britain. It is particularly fond of bees, but will eat various other insects; many of which it seizes, and, like the swallow, on the wing. When insects are with difficulty to be found, it feeds on many species of seeds. In the markets of Italy it is frequently to be seen among the poulterer's collections. It builds in the deep holes to be found on the banks of rivers. In the island of Candia these birds are often taken by boys, in the same manner as swallows, by a line with an insect attached to a hook at the end of it. The cockchafer is chiefly employed for this purpose; notwithstanding its being thus fastened, it continues its flight, and is thus the most effectual of the decoys used on those occasions.

MESEMBRYANTHEMUM, in botany, *fig-marigold*, a genus of the Icosandria Pentagynia class and order. Natural order of Succulentæ Ficoideæ, Jussieu. Essential character: calyx five cleft; petals numerous, linear; capsule fleshy, inferior, many seeded. There are seventy-five species, of which M. nodiflorum, Egyptian fig-marigold, is a native of Egypt, where they cut up the plants and burn them for potash: it is esteemed the best sort for making hard soap and the finer glass: it is an annual plant, with diffused, decumbent stems; calyxes five toothed, two of the teeth larger, leaf-shaped; petals flat, narrow, connate at the base; stigmas usually five. M. crystallinum, diamond fig-marigold, or ice plant: this is also an annual, distinguished by its leaves and stalks, being closely covered with pellucid pimples full of moisture, which, when the sun shines on them, reflect the light, appearing like small bubbles of ice, whence its name; many call it the diamond ficoides.

MESENTERY, a thick fat membrane, placed in the midst of the intestines, particularly of the smaller ones, whence it has the name.

MESPILUS, in botany, a genus of the Icosandria Pentagynia class and order. Natural order of Pomaceæ. Rosaceæ, Jussieu. Essential character: calyx five cleft; petals five; berry inferior, five-seeded. There are nine species, of which M. germanica, Dutch medlar; this tree never rises with an upright trunk, but sends out crooked deformed branches, not far from the ground; the leaves are large, entire, and downy on their under side; flowers very large, as is also the fruit, which is rounder, and approaches nearer to the shape of an apple. This tree, bearing the largest fruit, is now generally cultivated: the Nottingham medlar has a more poignant taste, but the fruit is considerably less.

MESSERSCHIMIDIA, in botany, so named from Daniel Gottlieb Messerschmid, a genus of the Pentandria Monogynia class and order. Natural order of Asperifoliæ. Borragineæ, Jussieu. Essential character: corolla funnel form, with a naked throat; berry suberous, bipartile, each two-seeded. There are two species, viz. M. fructicosa, and M. arguzia.

MESUA, in botany, so called from John Mesue, a physician, a genus of the Monadelphia Polyandria class and order. Natural order of Guttiferæ, Jussieu. Essential character; calyx simple, four leaved, corolla four petalled; pistil one; nut four cornered, one seeded. There is but one species, viz. M. ferrea, a native of the East-Indies; it is much cultivated in Malabar, for the beauty of the flowers: it bears fruit from the nut at six years old, and continues frequently bearing during three centuries. It is a very large tree, spreading like the lime; the flowers resemble our sweet briar roses, having only four white petals; the fruit when ripe has a rind like that of the chesnut, with three or four kernels within, of the substance, shape and taste of chesnuts.

METACARPUS, in anatomy, that part of the hand between the wrist and the fingers.

METALS, according to strict definition, are inflammable bodies, being all capable of combining with oxygen, and many of them, during this combination, exhibit the phenomena of combustion. Formerly only seven metals were known, but modern discoveries have added to the number about twenty others, which are distinguished by their great specific gravity, considerable tenacity and hardness, opacity, and property of reflecting the greater part of the light which falls on their surface, giving rise to what is denominated the metallic lustre or brilliancy. See LUSTRE. To these have been added two others, by Mr. Davy, who has discovered the method of decomposing potash and soda, and producing therefrom the new metals, called by that professor Potassium and Sodaium. See POTASSIUM and SODAIUM, under which terms a more particular account of these metals will be given. Of the others, the principal characteristic is their superior specific gravity. In this they exceed all other bodies, the lightest being about six times heavier than water, the common standard, while the specific gravity of the heaviest substance with which we are acquainted, that is not metal, is less than five times heavier than water. Opacity is another leading property of metals; even when beat to the greatest possible thinness, they transmit scarcely any light: from the union of the two qualities, density and opacity, arises that of lustre. By their opacity and the denseness of their texture, they reflect the greater part of the light that falls on their surface. From their density they are susceptible of a fine polish, by which their lustre is increased. Colour is not a characteristic property of metals, but it serves to distinguish them from each other. Their colours are generally shades of white, grey, or yellow. Tenacity distinguishes a number of the metals, and is not possessed in any great degree by other bodies; hence arises their MALLEABILITY and DUCTILITY, which see. Some of the metals are neither malleable nor ductile. Metals are less hard than the diamond and many fossils, and their elasticity follows the same order as their hardness. Both these qualities are greater in combinations of the metals than in the individual metals, and both may be increased by raising the metal to a high temperature, and then suddenly cooling it. Metals are the best conductors of caloric; their expansibilities are various, and are probably nearly in the order of their fusibilities. Mercury melts at so low a temperature, that it can be obtained in the solid state only at a very low temperature; others, as platina, can scarcely be melted by the most intense heat which we can excite. In congealing, some of the metals expand considerably, especially iron, bismuth, and antimony; the others contract, some of them to a great extent, the contraction of mercury being equal to the $\frac{1}{23}$rd of the whole volume. Metals may be volatilized; at the degree of 600 quicksilver may be volatilized; and zinc and arsenic at a temperature not very remote from this; many others may be dissipated in the focus of a large burning mirror, or by a powerful galvanic battery. Metals are the best conductors of electricity.

Metals are susceptible of combination; they have an affinity to oxygen, hydrogen, carbon, sulphur, phosphorus, and to each other, and, when combined with oxygen, to all the acids, to the alkalies, and to the earths. The metals, independently of potassium and sodaium, may be thus enumerated and arranged.

Metals
- oxydable by heat
  - acidifiable
    - volatile
      - Arsenic
    - fixed
      - Molybdena
      - Tungstin
      - Chrome
      - Columbium
  - not acidifiable
    - brittle
      - infusible or granular
        - Osmium
        - Uranium
      - fusible
        - Tantalium
        - Titanium
        - Tellurium
        - Manganese
        - Cobalt
        - Antimony
        - Bismuth
    - malleable
      - Zinc
      - Lead
      - Tin
      - Iron
      - Copper
      - Mercury
- not oxydable by heat
  - granular and brittle
    - Iridium
    - Rhodium
  - fusible and malleable
    - Palladium
    - Nickel
    - Platina
    - Silver
    - Gold

Metal, in heraldry. There are two metals used in heraldry, by way of colours, *viz.* gold and silver; in blason called *or* and *argent*. In the common painting of arms these metals are represented by white and yellow, which are the natural colours of those metals. In engraving, gold is expressed by dotting the coat, &c. all over; and silver, by leaving it quite blank.

It is a general rule in heraldry, never to place metal upon metal, nor colour upon colour; so that if the field be of one of the metals, the bearing must be of some colour; and if the field be of any colour, the bearing must be of one of the metals.

METALLURGY, comprehends the whole art of working metals, from the state of ore to the utensil; hence assaying, gilding, refining, smelting, &c. are only branches of metallurgy. In a more limited sense, it includes only the operations which are followed in separating metals from their ores. See Assaying, &c.

METAPHOR, in rhetoric, a trope, by which we put a strange word for a proper word, by reason of its resemblance to it; or it may be defined, a simile or comparison, intended to enforce and illustrate the thing we speak of, without the signs or forms of comparison.

METAPHYSICS. See Philosophy, *mental.*

METEOR, in physiology, a moveable igneous body, congregated in the air by means not thoroughly understood, and varying greatly in size and rapidity of motion. Many attempts have been and are still made to account for the formation and ignition of these grand objects. Dr. Woodward, of the old school, seems to have approached nearer to modern opinions, founded on recent observations, than any other writer on the subject. That gentleman supposed them to originate from mineral particles raised from the earth by subterraneous heat, accompanied by vapours from the same strata which furnished the minerals, and being condensed by the pressure of the atmosphere, partake of the immediate action of the bodies they intersect in their passage. Derham thought the ignis fatuus a vapour on fire; Beccaria, on the contrary, supposed them to be vapour forced out of the earth by the descent of rain or snow, and not decidedly burning, but rather of the nature of cold phosphori. Franklin conjectures, in the Memoirs of the Manchester Society, that the dense fog of 1783, may have been produced by smoke, arising from the combustion of some of those vast globes, "which we happen to meet with in our rapid course round the sun." The generality of the meteors observed resemble each other, except in size, which cannot be ascertained with certainty, on account of the apparent diminution of bodies through distance. The most remarkable of late times were those of 1783 and 1805: the former was very luminous, and its supposed diameter one thousand yards: the latter passed with such astonishing rapidity, that amazement had not subsided ere it vanished, consequently very little dependence can be placed on what has been said concerning its bulk and shape; the light which it emitted was a pale blue, and almost as instantaneous as a flash of lightning, and the rushing of the enormous body produced a sound like very distant thunder. Some of the smaller meteors explode after a certain interval of burning, and it has been uniformly asserted that they deposited stones; the apparent improbability of this assertion long prevented persons of enlightened minds from crediting it, and till Dr Chladni published a dissertation on the subject in 1794, which induced Mr. King to collect every instance, ancient and modern, calculated to establish the fact with the public, and this was no easy task. Mr. Howard followed the example of those two gentlemen; but went further, and actually procured specimens of the substances alluded to, which, having compared, he proceeded to analyze by chemical means. He found them entirely different from all known stones, and exactly resembling each other, even in their component parts.

It has been said that the stones, thus incontestibly proved by different authorities, and from various places, to have fallen after the explosion of meteors, are heated and luminous when they reach the earth: the force of their descent buries them some depth into it, and they have been seen under these circumstances in Italy, Germany, France, England, and India. The meteors either really do, or appear to, move horizontally, and are said to descend ere they explode. The stones are of different sizes, and from a few ounces in weight to several tons: they are generally circular, and invariably covered with a rough black crust, which, according to Howard, is principally composed of oxide of iron. The process adopted by that gentleman produced a result, which has since been confirmed by Klaproth and Vauquelin. We shall give the analysis of two of these substances, by Howard, of a stone which fell in Yorkshire; and by Vauquelin and Fourcroy, of another that fell at Laigle, in France, 1803

Mr. Howard found that 150 grains contained

75	Silica
37	Magnesia
48	Oxide of iron
2	Oxide of nickel
162	

The oxydizement of the metallic bodies caused this increase of weight. Messrs. Vauquelin and Fourcroy found the mass they examined contained

54	Silica
36	Oxide of iron
9	Magnesia
3	Oxide of nickel
2	Sulphur
1	Lime
105	

The conjectures which these extraordinary productions have occasioned are visionary in the extreme: indeed, M. Laplace supposes them to be fragments ejected by volcanoes in the moon: Sir William Hamilton and Mr. King, on the contrary, imagine that they are concretions formed in the atmosphere.

METEOROLOGY, is the science of studying the phenomena of the atmosphere, and the term by which is expressed all the observations that tend to make them a system. There are many most important meteorological phenomena, and those may be classed under five distinct heads; for instance, the alterations that occur in the weight of the atmosphere, those that take place in its temperature, the changes produced in its quantity by evaporation and rain, the excessive agitation to which it is frequently subject, and the phenomena arising from electric and other causes, that at particular times occasion or attend the precipitations and agitations alluded to.

All the above phenomena prove to demonstration, that constant changes take place, the consequences of new combinations and decompositions rapidly following each other. The majority of meteorological alterations depend on these chemical changes, and were we accurately acquainted with the peculiarities of all the substances which form the component parts of the atmosphere, nothing would be more easy than to explain the result of their mutual action; but as that is unfortunately not the case, we must be contented to build upon strong probabilities, supported in many instances by positive experiment.

It is singular, that this science should have remained for so long a period in a state of comparative neglect, when it is recollected, that almost all the operations necessary for the support of human life, and almost all the comforts of corporeal feeling, depend upon the state of the atmosphere, and yet nothing was attempted to any purpose towards investigating the laws of meteorology till the seventeenth century, when the most important discoveries of the barometer and thermometer occurred, which was followed in the eighteenth by the invention of excellent hygrometers and electrometers; by these the philosopher finds himself competent to make accurate and satisfactory observations. Scientific persons, who have particularly turned their attention to this pursuit, have undertaken the laborious task of collecting and methodically arranging numbers of the observations just mentioned, and after attentively comparing and examining them, have formed theories of the weather of more or less probable accuracy; but the science is of such difficulty, that though those theories deserve every praise, we are compelled to acknowledge the phenomena of the weather is still very imperfectly understood. This acknowledgement, however, reflects no discredit on those ingenious men, as it is impossible that any thing like certainty should be attained, till observations that can be depended upon are procured from all parts of the globe, the atmosphere has been more accurately explored, and the chemical changes occurring in it are correctly ascertained.

To render our explanation of this subject as satisfactory as circumstances will permit, we shall proceed in the succession before pointed out; with respect to the changes in the weight of the atmosphere, it is generally known that the instrument called the barometer shews the weight of a body of air immediately above it, extending to the extreme boundary of the atmosphere, and the base of which is equal to that of the mercury contained within it. As the level of the sea is the lowest point of observation, the column of air over a barometer placed at that level is the longest to be obtained; in this case the mean height of the barometer is thirty inches. According to the experiments of Sir George Shuckburgh in the Channel and the Mediterranean Sea, in the temperature of 55° and 60°, this was found to be the case, and the result is confirmed by those of M. Bouguer on the coast of Peru, in the temperature of 84°, and Lord Mulgrave in latitude 80°. From these data it is evident, that the mean height of the barometer decreases in proportion with its elevation above the level of the sea, and in proportion to the consequent shortening of the columns of air; hence it is used for measuring heights. The keeping of a barometer in one particular place does not make the mercury stationary, as it will vary by rising or falling to the extent of several inches; of necessity the weight of the air which balances the mercury must be subject to the same changes; this circumstance proves that the gravity of the air in any given situation varies greatly, being at one time light, and another heavy, an effect which must be caused by changes in its quantity, and a fact that demonstrates the air of every place liable to perpetual alterations, which must arise from the accumulation of air in particular places, and a reduction in others, "or," as Dr. Thomson observes, "part of the atmosphere must be alternately abstracted altogether, and restored again by some constant, though apparently irregular process."

The variations of the barometer between the tropics are very trifling, and it is worthy of observation, it does not descend more than half as much in that part of the globe for every two hundred feet of elevation as it does beyond the tropics, which we learn from the Journal de Physique; besides, the barometer rises about two-thirds of a line twice during each day in the torrid zone. We are informed by M. Horsburgh, that from latitude 26° north to latitude 27° south, which includes the space termed the tropical seas, the mercury attained its greatest elevation at eight in the morning, from which hour till noon it continued stationary; it then began to fall, and descended till about four o'clock, when it reached the lowest point of depression. In the interval between four and five the mercury rose, and continued to rise till about nine or ten P. M. when it had once more arrived at its most elevated point, where it remained stationary till near midnight, when it fell, and continued to fall, till at four A. M. it had descended as low as it had been at four in the afternoon; from that period till seven or eight it continued rising, and at the latter hour it had attained the highest point of elevation. The gentleman who made these observations termed the elevations and depressions now described equatropical motions, and asserts that they were regularly performed while the barometers were on the sea, but they were seldom observed on a river, or when the instruments were on shore. This circumstance leads us to concur with Dr. Thomson, in supposing that the singular fact is to be ascribed to the motion of the ship, "which, by regularly agitating the mercury, might make its elevations and depressions more sensible and correct than when the barometer continues stationary." The range of the barometer increases gradually as the latitude advances towards the poles, till in the end it amounts to two or three inches. The following table, composed by the writer just cited, will explain the gradual increase alluded to, which he compiled from the best authorities.

Latitude		Places	Range of the barometer			
			Greatest		Annual	
0°	0′	Peru	0	20	-	—
22	23	Calcutta	0	77	-	—
33	55	Cape Town	-	—	0	89
40	55	Naples	1	00	-	—
51	8	Dover	2	47	1	80
53	13	Middlewick	3	00	1	94
53	23	Liverpool	2	89	1	96
59	56	Petersburgh	3	45	2	77

The range of the barometer is considerably less in North America than in the corresponding latitudes of Europe, particularly in Virginia, where it never exceeds 1.1. The range is more considerable at the level of the sea than on mountains, and in the same degree of latitude it is in the inverse ratio of the height of the place above the level of the sea.

M. Cotte composed a table, which has been published in the Journal de Physique, from which it appears extremely probable, that the barometer has an invariable tendency to rise between the morning and the evening, and that this impulse is most considerable from two in the afternoon till nine at night, when the greatest elevation is accomplished; but the elevation at nine differs from that at two by four-twelfths, while that of two varies from the elevation of the morning only by one-twelfth, and that in particular climates the greatest elevation is at two o'clock. The observations of M. Cotte confirm those of Mr. Luke Howard, and from them it is concluded, that the barometer is influenced by some depressing cause at new, and full moon, and that some other makes it rise at the quarters. This coincidence is most considerable in fair and calm weather; the depression in the interval between the quarters and conjunctions amounts to one-tenth of an inch, and the rise from the conjunctions to the quarters is to the same amount.

The range of this instrument is found to be greater in winter than in summer; for instance, the mean at York, during the months from October to March inclusive, in the year 1774, was 1.42, and in the six summer months 1.016.

The more serene and settled the weather is, the higher the barometer ranges, calm weather with a tendency to rain depresses it, high winds have a similar effect on it, and the greatest elevation occurs with easterly and northerly winds, but the south produces a directly contrary effect. According to the Asiatic Researches, it is always observed to be highest with north and north-west winds, and the reverse when the south-east prevails; it falls rapidly previous to violent tempests, and is greatly agitated while they continue. It has been remarked by Mr. Copland, in the Transactions of the Society of Manchester, that "a high barometer is attended with a temperature above, and a low barometer with one below, the monthly mean." Various but almost altogether unsuccessful attempts have been made to explain the phenomena we have enumerated; that of Mr. Kirwan carries considerable plausibility, though it is not considered quite satisfactory. In order that his ideas on the subject may be clearly understood, we shall give what may be considered an abstract of his theory, improved by Dr. Thompson. The density of the atmosphere is evidently greatest at the poles, and least at the equator, as the centrifugal force at the latter, the distance from the centre of the earth, and the heat, all contributing to lessen the density of the air, are at their maximum, when at the pole it is exactly the reverse. In every part of the world the mean height of the barometer placed at the level of the sea will be found to be 30 inches, consequently the weight of the atmosphere is the same in all places: its weight depending on its density and height; where the former is greatest the height must be the least, and where its density is least the height is the greatest. Arguing from these facts, it will, therefore, appear that the height of the atmosphere must be least at the poles, and greatest at the equator, decreasing gradually in the interval, and thus forming the resemblance of two inclined planes, meeting at the highest part above the equator.

The difference of the mean heat between the pole and the equator, when the sun is in our hemisphere in the summer, does not vary so much as in the winter, as the heat at that period in northern countries equals that of the torrid zone; hence the thermometer rises to 85° in Russia during the months of July and August; of necessity the rarity of the atmosphere and its height increases; in consequence, the upper part in the northern hemisphere inclines less, but that of the southern, from different causes, must be much more inclined; during our winter the exact reverse takes place.

The pressure of the superincumbent column in a great measure causes the density of the atmosphere, and therefore decreases in proportion to the height as the pressure of the column constantly decreases, yet the density in the torrid zone does not decrease so rapidly as in the temperate and frigid, as the column is longer, and because there is a larger proportion of air in the upper part of it. This fact agrees with the assertion of M. Cassan, "that the barometer only sinks half as much for every two hundred feet of elevation in the torrid, as in the temperate zones." The density at the equator, though less at the surface of the earth, must equal at a certain height, and still higher exceed the density in the temperate zones, and at the poles.

It was ascertained that a current of air constantly ascends at the equator, part at least of which reaches to and remains in the highest part of the atmosphere; the fluidity of that body prevents it from accumulating above the equator, and hence it must descend the inclined plane before mentioned. The surface of the atmosphere being more inclined in the northern hemisphere during our winter than that of the southern, more of the current must flow on the northern than on the southern, from which cause the quantity of our atmosphere is greater in winter than that of the southern hemisphere; in the summer it is just the contrary; consequently, the range of the barometer is less in summer than in winter, and the greatest mercurial heights occur during winter.

The heat of any given place in a great measure influences the density of its atmosphere; that density will be most considerable where it is coldest, and its columns shortest. Chains of mountains, the summits of which are covered with snow great part of the year, and highlands, must be colder than places less elevated in the same latitude, and the column of air over them much shorter. The current of air above must be impeded and accumulate while on its passage over these places towards the poles, which causing an agitation, it will be communicated to, and indicated by, the barometer in a singular manner. These accumulations occur over the north-west parts of Asia and North America, and this raises the barometer, and causes less variation in it there than in Europe. It is precisely so on the Pyrenees, the Alps, and the mountains in Africa, Turkey in Europe, Tartary, and Tibet. After the accumulations have existed some time, the surrounding atmosphere becomes incapable of balancing the density of the air, when it descends with violence, and occasions cold winds, which raise the barometer; it is to this that we are to attribute the rise of the barometer almost always attending north-east winds in Europe, which is the effect of accumulations near the pole, or in the north-west parts of Asia; it is thus, besides, that the north-west wind from the mountains of Tibet raises the barometer at Calcutta. It may be supposed that in the polar regions large quantities of air are casually compressed; when this is the case, the southern atmosphere must rush in to replace it, which occasions south-west gales and the fall of the barometer.

The mean heat of our hemisphere varying in successive years, the density of the atmosphere, and necessarily the quantity of equatorial air passing towards the poles, cannot be otherwise than variable; hence occurs the different ranges of the barometer in successive years; at some particular periods, more considerable accumulations take place in the highest parts of Asia, and the south of Europe, than at others, which may be produced by early falls of snow, or the interruption of the sun's rays by long continued fogs; at such times the atmosphere in the polar regions becomes proportionably lighter, and this causes the prevalence of southerly winds in some winters more than in others. The heat of the torrid zone never greatly varying, the height and density of the atmosphere undergoes but few changes, thence arises the comparatively small range of the barometer within the tropics, which gradually increases towards the poles as the difference of the temperature, and the density of the atmosphere increases with the latitude. The sinking of the barometer preceding violent tempests, and the oscillations during their continuance, prove that very great rarefactions, or even destruction of air, in some part of the atmosphere, produces these phenomena; the fall too that accompanies winds arises from the same cause. Unfortunately we are but little acquainted with the operations which produce rain, consequently we are unable to explain satisfactorily why the barometer falls immediately preceding it.

The most inattentive observer of the phenomena of nature must have noticed, that there are considerable variations in the temperature of the air in any particular place, exclusive of the differences of seasons and climates, which eternal changes cannot be produced by heat derived from the sun, as its rays concentrated have no kind of effect on air; those however heat the surface of our globe, which is communicated to the immediate atmosphere; it is through this fact that the temperature is highest where the place is so situated as to receive with most effect the rays of the sun, and that it varies in each region with the season; it is also the cause why it decreases in proportion to the height of the air above the surface of the earth. The most perpendicular rays falling on the globe at the equator, there the heat of it is the greatest, and that heat decreases gradually to the poles; of course the temperature of the air is in exact unison; from this it appears, that the air acquires the greatest degree of warmth over the equator, whence it becomes insensibly cooler till we arrive at the poles: in the same manner, the air immediately above the equator cools gradually. Though the temperature sinks as it approaches the pole, and is highest at the equator, yet, as it varies continually with the seasons, it is impossible to form an accurate idea of the progression, without forming a mean temperature for a year, from that of the temperature of every degree of latitude for every day of the year, which may be accomplished by adding together the whole of the observations, and dividing by their number, when the quotient will be the mean temperature for the year. "The diminution," says Dr. Thomson, "from the pole to the equator takes place in arithmetical progression; or, to speak more properly, the annual temperature of all the latitudes are arithmetical means between the mean annual temperature of the equator and the pole." Mr. Mayer has the honour of this discovery, but Mr. Kirwan rendered it more simple and plain, by founding an equation on it, by which he calculated the annual mean temperature of every degree of latitude between the equator and the pole; the following was the principal of proceeding: "Let the mean annual heat at the equator be m, and at the pole $m - n$; put Φ for any other latitude; the mean annual temperature of that latitude will be $m - n \times \sin. \Phi^2$. If therefore the temperature of any two latitudes be known, the value of m and n may be found. Now the temperature of north lat. 40° has been found by the best observations to be 62.1°, and that of lat. 50°, 52.9°. The square of the sine of 40° is nearly 0.419, and the square of the sine of 50° is nearly 0.586. Therefore,

$m - 0.41\,n = 62.1$, and
$m - 0.58\,n = 52.9$, therefore
$62.1 + 0.41\,n = 52.9 + 0.58\,n$ as each of them from the two equations is equal to m. From this last equation the value of n is found to be 53 nearly; and m is nearly equal to 84. The mean temperature of the equator, therefore, is 84°, and that of the pole to 31°. To find the mean temperature for every other latitude, we have only to find 88 arithmetical means between 84 and 31."

Mr. Kirwan calculated a table of the mean annual temperature of the standard, situated in every latitude, which answers only for those of the atmosphere of the ocean, as it was made for that part of the Atlantic situated between 80° north and 45° south latitude, extending westward to the gulf stream, within a few leagues of the American coast; and for all that part of the Pacific Ocean, from the 45th degree of northern to the 40th of southern latitude, from the 20th to the 275th degree of longitude east of London. Mr. Kirwan terms this part of the ocean the standard, as the rest is subject to anomalies to be mentioned hereafter. The same industrious gentleman ascertained the monthly mean temperature of the standard ocean; that of April approaches very nearly to the annual mean, "and as far as heat depends on the action of solar rays, that of each month is as the mean altitude of the sun, or rather as the sine of the sun's altitude." The learned investigators, to whom we are indebted for these experiments and observations, say, "As the sine of the sun's mean altitude in April is to the mean heat of April, so is the sine of the sun's mean altitude in May to the mean heat of May. In the same manner the mean heats of June, July, and August, are found; but the rule would give the temperature of the succeeding months too low, because it does not take in the heat derived from the earth, which possesses a degree of heat nearly equal to the mean annual temperature. The real temperature of these months, therefore, must be looked upon as an arithmetical mean between the astronomical and terrestrial heats. Thus, in latitude 51°, the astronomical heat of the month of September is 44.6°, and the mean annual heat is 52.4; therefore the real heat of this month should be $\frac{44.6+52.4}{2} = 48.5$.

After many laborious calculations, Mr. Kirwan had the mortification to find their results differed so much from observations, that he was induced to make a table from various sea journals, and certain principles, for the monthly mean temperature of the standard, from lat. 80° to lat. 10°, from which he decides, that the coldest month in every latitude is January, and that July is the warmest in all above 48°; in lower, August. In proportion to the distances from the equator is the increase and decrease of heat, but every latitude where existence can be maintained has a mean of 60°, two months of the year at the least, which is requisite for the production of those articles by which man supports life. The temperatures within ten degrees of the poles vary little, and the case is similar within the same distance from the equator; those of different years near the latter differ very little, but the differences increase as the latitudes approach the poles. It is well known that the temperature of the atmosphere diminishes gradually in proportion to its height above the level of the sea. The late Dr. Hutton of Edinburgh made some experiments on this head, by placing a thermometer on the summit of Arthur's Seat, a hill so named, and another at the base of it, by which he found that the former generally stood at three degrees lower than the latter; in this instance therefore a height estimated at 800 feet produced a diminution of heat amounting to three degrees. Bouguer made a similar experiment, to ascertain the difference of temperature between the level of the sea and the top of Pinchinca, one of the Andes, when the thermometer at the summit stood at 30°, and that below in the same latitude at 84°; the diminution was 54° in a supposed height of 15,564 feet. Thus far the operation is easy and practicable, but the grand difficulty lies in determining the exact gradations between the highest and lowest points of observation; conjectures on this subject have been hazarded by Euler and Saussure; the first gives it in harmonic progression, and Saussure supposed the decrease of temperature to amount to 1° for 287 feet of ascent. Mr. Kirwan, however, rejecting those improbabilities, shows, in the Transactions of the Royal Irish Academy, that the rate of diminution depends upon the precise temperature of the surface of the earth where an experiment is made; he has besides invented an ingenious mode of ascertaining the rate in every instance, admitting the temperature at the surface to be known.

This gradual approach to cold demonstrates, that at a certain height eternal congelation must prevail; that height varies of course according to the latitude of the place, being highest at the equator, and gradually descending on approaching the poles; it is also lower in the winter. The cold on the summit of Pinchinca was found, by M. Bouguer, to extend from seven to nine degrees every morning, previous to the rising of the sun, below the freezing point, from which he conjectured, that the mean height of the term of congelation (or that region where water congeals on some part of every day in the year) between the tropics, is 15,577 feet above the level of the sea; in latitude 28°, he supposes it to be 13,540 during summer; taking the difference between the freezing point and the equator, it plainly appears, that it bears the same proportion to the term of congelation at the equator, that the difference between the mean temperature of any other degree of latitude, and the freezing point, bears to the term of congelation in that latitude." "Thus," continues Dr Thomson, "the mean heat of the equator being 84°, the difference between it and 32 is 52; the mean heat of latitude 28° is 72.3°, the difference between which and 32 is 40.3. Then 52: 15,577 : : 40.3 : 1207.2." Mr. Kirwan calculated another table on this subject, from latitude 0, where he makes the mean height of the term of congelation 15,577, by gradations of five degrees, up to latitude 80—120 feet; higher than this, called the lower term of congelation, which varies with circumstances and seasons, M. Bouguer places another, called by him the upper term, and beyond this no visible vapour ascends. The former gentleman supposes this line far less liable to variation in the summer than in the lower term, and therefore adopted it to ascertain the rate of diminution of heat on ascending into the atmosphere. Bouguer determined the height of this term in one instance, but Kirwan went further, and produced a table of its height for every degree of latitude in the northern hemisphere. We shall quote Mr. Kirwan's rule for obtaining the temperature at any given height, admitting that the temperature at the surface of the earth is known. "Let the observed temperature at the surface of the earth be $= m$, the height given $= h$, and the height of the upper term of congelation for the given latitude be $= t$; then $\frac{m - 32}{\frac{t}{100} - 1} =$ the diminution of temperature for every 100 feet of elevation; or it is the common difference of the terms of the progression required. Let this common difference thus found be denoted by c, then $c \times \frac{h}{100}$ gives us the whole diminution of temperature from the surface of the earth to the given height. Let this diminution be denoted by d, then $m - d$ is obviously the temperature required. An example will make this rule sufficiently obvious. In latitude 56°, the heat below being 54°, required the temperature of the air at the height of 803 feet.

Here $m = 54$, $t = 5{,}533$, $\frac{m \quad 32}{\frac{t}{100} \quad 11} =$ $\frac{22}{54\ 33} = 0.404 = c$, and $c \times \frac{h}{100} =$ $0.404 \times 8.03 = 3.24 = d$, and $m - =$ $54 - 3.24 = 50.75$: here we see that the temperature of the air 803 feet above the surface of the earth is 50° 75″.

Estimating the diminution from this method, which corresponds with observation, we find that heat lessens in an arithmetical progression; and from the same premises it may be concluded, that the warmth of the air at some distance from the earth is not to be attributed to the rising of heated strata of air from the earth's surface, but to the conducting power of the air.

The upper strata of the atmosphere are frequently warmer in winter than the lower, and the preceding rule is applicable to the temperature of the air during the summer months only. According to the Philosophical Transactions for 1717, a thermometer placed on the summit of Arthur's Seat, the thirty-first of January, the year before, stood six degrees higher than a second at Hawkhill, situated 684 feet below it: this superior heat is considered by Mr. Kirwan to be produced by a current of heated air flowing from the equator towards the north pole during our winter. A general idea has now been given of the method by which the mean annual temperature may be found throughout the known regions of the globe; but there are some exceptions to the universality of the rules: for instance, the Pacific Ocean, between latitude 52° and 66° north, and at the northern extremity, is only forty-two miles in breadth, and at its southern is one thousand three hundred miles; it is therefore but reasonable to suppose, that the temperature must be greatly affected by the land surrounding it, which rises into chains of mountains, with summits bearing snow great part of the year, exclusive of the islands consisting of high lands scattered within it. Mr. Kirwan concludes, in consequence, that its temperature is four or five degrees below the standard. This supposition cannot, however, be brought to any degree of certainty, from a deficiency of observations. It has been a generally received opinion, that the southern hemisphere, beyond the fortieth degree of latitude, is much colder than corresponding parts of the northern: this our philosopher has proved to be true, with respect to the summer of the former; but that the winter in the same latitude is milder than in the latter.

Inconsiderable seas, in temperate and cold climates, are colder in winter and warmer in summer than the standard ocean, as they are necessarily under the influence of natural operations from the land, and its temperature, particularly the Gulph of Bothnia, which is generally frozen in the winter, but the water is sometimes heated in the summer to 70°, a state the opposite part of the Atlantic never acquires; the German Sea is five degrees warmer in summer than the Atlantic, and more than three colder in winter; the Mediterranean is almost throughout warmer, both in winter and summer, which therefore causes the Atlantic to flow into it; and the Black Sea, being colder than the Mediterranean, flows into the latter.

It appears from meteorological tables, that the eastern part of North America has a much colder air than the opposite

European coast, and falls short of the standard by about ten or twelve degrees. There are several causes which produce this considerable difference. The greatest elevation in North America is between the 40th and 50th degree of north latitude, and the 100th and 110th of longitude west from London, and there the most considerable rivers have their origin. The height alone is sufficient to make this tract colder than it would otherwise be; but there are other causes, and those are most extensive forests, and large swamps and morasses, each of which exclude heat from the earth, and consequently prevent it from ameliorating the rigour of winter. Many extensive lakes lie to the east, and Hudson's Bay more to the north; a chain of mountains extends on the south of the latter, and those equally prevent the accumulation of heat; besides, this bay is bounded on the east by the mountainous counties of Labrador, and has many islands; from all which circumstances arise lowness of the temperature, and the piercing cold of the north-west winds. The annual decrease of the forests for the purpose of clearing the ground, and the consumption for building and fuel, is supposed to have occasioned a considerable decrease of cold in the winter; and if this should be the result, much will yet be done towards bringing the temperature of the European and American continents to something like a level.

Continents have a colder atmosphere than islands situated in the same degree of latitude, and countries lying to the windward of the superior classes of mountains, or forests, are warmer than those which are to the leeward. Earth, always possessing a certain degree of moisture, has a greater capacity to receive and retain heat than sand or stones, the latter therefore are heated and cooled with more rapidity: it is from this circumstance that the intense heats of Africa and Arabia, and the cold of Terra del Fuego are derived. The temperature of growing vegetables changes very gradually; but there is considerable evaporation from them: if these exist in great numbers, and congregated, or in forests, their foliage preventing the rays of the sun from reaching the earth, it is perfectly natural that the immediate atmosphere must be greatly affected by the ascent of chilled vapours.

Our next object is the ascent and decent of water. The first mentioned operation of this fluid has been noticed already. See Evaporation.

Dews, the effect of the same cause, are variously accounted for by different observers of nature; the general result, however, seems to be, that they are the last feeble efforts of evaporation, which, deprived of their warm stimulus by the approach of night, fall through the chill of the air in extremely small and distinct globules, covering every substance with that trembling and brilliant lustre, which rain is incapable of affording through the weight of each drop. According to Hales, 3.28 inches of dew annually falls on the earth; but Dalton asserts, that the quantity is about five inches in the same period. M. Prevost made some curious experiments, to ascertain why dew should be deposited on glass, when it did not adhere to metal almost in contact: plates of metal fixed on glass are sometimes covered by dew, and at others the case is reversed; in the latter instance they are bounded by a dry zone: if the other surface of the glass is exposed, the part opposed to the metal remains perfectly dry, and if the metal is applied again, it will not prevent the deposition. The experiment may be made at a window, when moisture attaches to either side. M. Prevost observes, that glass is covered externally, even when the air is warmest within the house, and that metal fixed internally receives more moisture than the glass. After pursuing the subject to its utmost limits, this gentleman concludes that the phenomena are entirely the effect of the action of heat. That description of dew known by the name of honey-dew is attributed to insects.

The strata of air near the surface of the earth unquestionably contains more moisture, or vapour, than the higher parts of the atmosphere. The regions above the summits of mountains are probably very dry; and De Luc and Saussure say, the air on those they explored was less impregnated with vapour in the night than during the day; for as the stratum next the earth condenses and cools at the former period, there can be no doubt that each stratum descends, yet as clouds are seen to tower far above the most elevated peaks, vapour must at particular times rise to an amazing height.

Rain never descends till the transparency of the air ceases, and the invisible vapours become vesicular, when clouds form, and at length the drops fall: clouds, instead of forming gradually at once throughout all parts of the horizon, generate in a particular spot, and imperceptibly increase till the whole expanse is obscured. It is singular, that clouds collect and spread at a considerable height in the atmosphere, where the air is drier than in the lower strata, which are generally overcharged with moisture. "It is equally remarkable," says a late writer, "that the part of the atmosphere at which they form has not arrived at the point of extreme moisture, nor near that point, even a moment before their formation." Thus it appears, that their formation does not proceed from a greater quantity of vapour accumulating than could remain in the atmosphere without passing its maximum. M. De Luc asserts, that the heat of clouds exceeds that of the surrounding air in some particular instances; hence their formation cannot arise from the capacity of air for combining with moisture being decreased by cold, as clouds may frequently be observed, which, after floating through the atmosphere during the heat of the day, disappear at night when the heat diminishes: thus we might proceed to prove that clouds do not originate in the way supposed by many observers, and that we are still ignorant in what manner vapour is disposed of after it enters the atmosphere; and why it rejects its assumed form, returns again to vapour, and falls in rain; and why evaporation should prevail during very hot and dry seasons, without visibly saturating the whole atmosphere. Theories in this instance are of very little use, as the subject is evidently placed too far out of our reach for experiment: in this state of uncertainty we must have recourse to facts.

The quantity of rain taken at an annual means, is the greatest at the equator, and it lessens gradually to the poles; but there are fewer days of rain there, the number of which increase in proportion to the distance from it. The Journal de Physique contains the following observations: "From north latitude 12° to 43°, the mean number of rainy days is 78; from 43° to 46°, the mean number is 103; from 46° to 50, 134; and from 51° to 60°, 161." Winter often produces a greater number of rainy days than summer, though the quantity of rain is more considerable in the latter than in the former season: at Petersburgh rain and snow falls on an average 84 days of the winter, and the quantity amounts to about five inches; on the contrary, the summer produces eleven inches in about the same number of days. Mountainous districts are subject to great falls of rain; among the Andes, particularly, it rains almost incessantly, while the flat country of Egypt is consumed by endless drought. The rain gauge affords reason to suppose, that a greater quantity of rain falls in the lower strata of the atmosphere than in those above, which may be accounted for by the drops attracting vapour in their near approach to the earth, though it must be admitted, that Mr. Copland, of Dumfries, discovered the rain collected in the lower gauge was greatest when it continued falling for some time, and that the greatest quantity was collected in the higher during short rains, or at the conclusion of lengthened ones.

As rain is known to fall at all hours of the day and night, and at every season of the year, it is apparent that it is caused by operations which prevail eternally, and without defined interruption. M. Toaldo seems to think that a greater quantity descends in the night than the day; and it is certain that a south wind produces more rain than any other, though it falls during the prevalence of every wind: heavy falls also occur in the most complete calms. M. Cotte published a paper in the Journal de Physique, from which it appears that the mean quantity of rain descending at 147 places, between latitude 11° and 60° north, is 34.7 inches. "Let us suppose then," observes Dr. Thompson, "(which cannot be very far from the truth) that the mean annual quantity of rain for the whole globe is 34 inches. The superficies of the globe consists of 170,981,012 square miles, or 686,401,498,471,475,200 square inches: the quantity of rain, therefore, falling annually will amount to 23,337,650,812,030,156,800 cubic inches, or somewhat more than 91,751 cubic miles of water."

There are 52,745,253 square miles of dry land on the globe: consequently the annual amount of the quantity of rain descending upon it will be 30,960 cubic miles. The sea is supposed to receive 13,140 cubic miles of water, which flows into it annually; therefore it must supply an equal quantity by evaporation, or the land would be completely drained of every particle of moisture. Mr. Dalton estimates the quantity of rain falling in England at 31 inches.

Exclusive of the general appearance of vapour when condensed into clouds, there are other forms in which the existence of moisture in the atmosphere is observable, particularly the halo, a luminous circle appearing under certain circumstances round the sun, moon, and stars. This has been almost universally ascribed to the rays of light issuing from those bodies passing through a frozen medium of hail or snow; and that this may be the case admits of very little doubt; but it is equally probable, that the rays of the sun, breaking through an uniformly dense cloud, nearly exhausted by rain falling from it, may produce a similar effect on moisture in a fluid state, and this is demonstrated frequently by the sun appearing through such clouds. The parhelia, or mock sun, is another phenomena, effected by the rays of the sun darted upon frozen or fluid particles of water on either side of that body; but the exact manner in which this appearance originates cannot, for obvious reasons, be ascertained.

A constant attendant upon each of the phenomena that we have attempted to illustrate is wind, the doctrine of which deserves every possible attention, as much of our comfort, and health, and commerce wholly depends upon it. Were it not for this agitation of the air, putrid effluvia, arising from the habitations of man, and from vegetable substances, besides the exhalations from water, would soon render it unfit for respiration, and a general mortality would be the consequence. In this instance also the philosopher finds his progress arrested, and his research bounded by insurmountable obstacles; still, however, there are many facts established that are highly satisfactory. The temperate zones are not under the influence of as regular winds as between the tropics; the *trade wind* prevails annually and regularly in those parts of the Pacific and Atlantic oceans which lie near the equator; it blows from the north-east within a few points on the north side of the equator, and from the south-east on the opposite side; and the interval space of these separate winds is from the second to the fifth degree of north latitude, and within the limits just mentioned, where the wind may be said never to blow from the north or the south: but there are dreadful storms, and perfect calms, equally dangerous and perplexing to the mariner, who finds the force of the trade winds decline as he approaches their boundary. Between the tenth and thirteenth degrees of south latitude the trade wind prevails in the Indian ocean; but north of it there is a change every half year, when they blow in an opposite direction to their previous course: these are termed monsoons, and their change is constantly productive of variable airs and storms of extreme violence, which frequently continue from five to six weeks, during which period the navigation is very dangerous. The monsoons take place one on the south and the other on the north side of the equator in the Indian Ocean, and they extend to the eastern coast of China, and the longitude of New-Holland, from Africa: they, however, suffer partial changes through local circumstances. They are, besides, not altogether confined to the space just mentioned, as the wind blows from the east or north-east between September and April, and for the remainder of the year from the south-west, on the coast of Brazil, between Cape St. Augustine and the isle of St. Catherine. Having thus directed the attention of the reader to this part of the subject, we shall pass to the prevailing winds of our native country, which were ascertained by order of the Royal Society of London, which learned body published the following result in their Transactions.—At London.

Winds.	Days.	Winds.	Days.
South-west .	112	South-east . .	32
North-west . .	58	East	26
North-west . .	50	South	18
West	53	North	16

The same register shews, that the south-west wind blows more upon an average in each month of the year than any other, particularly in July and August; that the north-east prevails during January, March, April, May, and June, and is most unfrequent in February, July, September, and December; the north-west occurring more frequently from November to March, and less so in September and October than in any other months. In the fifth volume of the Statistical Account of Scotland there is a table of seven years close observation, made by Dr. Meek, near Glasgow, the average of which is stated as follows:

Winds.	Days.	Winds.	Days.
South-west . .	174	North-east .	104
North-west . .	40	South-east .	47

In Ireland the prevailing winds are the west and south-west. The different degrees of its motion next excites our attention; and it seems almost superfluous to observe, that it varies in gradations from the gentlest zephyr, which plays upon the leaves of plants, gently undulating them, to the furious tempest, calculated to inspire horror in the breast of the most callous; it is also a most remarkable fact, that violent currents of air pass along, as it were within a line, without sensibly agitating that beyond them. An instance of this kind occurred at Edinburgh, when the celebrated aeronaut Lunardi ascended in his balloon, which was conveyed with great velocity by the wind, at the rate of 70 miles an hour, while a perfect calm existed in the city and neighbourhood.

There are many circumstances attending the operations of the air, which we term wind, that serve for a basis for well-founded conjectures, and those united to the results of daily observation render the explanation of its phenomena tolerably satisfactory. It must be clear to the most common capacity, that as the rays of the sun descend perpendicularly on the surface of the earth under the torrid zone, that part of it must receive a greater portion of heat than those where they fall obliquely; the heat thus acquired communicates to the air, which it rarefies and causes to ascend, and the vacuum occasioned by this operation, is immediately filled by the chill air from the north and south. The diurnal motion of the earth gradually lessens to the poles from the equator: at that point it moves at the rate of fifteen geographical miles in a minute: this motion is communicated to the atmosphere in the same degree; therefore, if part of it was conveyed instantaneously from latitude 30°, it would not directly acquire the velocity of that at the equator, consequently the ridges of the earth must meet it, and give it the appearance of an east wind; the effect is similar upon the cold air proceeding from the north and south, and this similarity must be admitted to extend to each place particularly heated by the beams of the sun.

The moon being a large body, situated comparatively near the earth, is known to affect the atmosphere in its revolutions by the pressure of that upon the sea, so as to cause the flux and reflux of it, which we term tides; it cannot, therefore, be doubted that some of the winds we experience are caused by her motion.

The regular motion of the atmosphere, known by the name of land and sea-breezes, may be accounted for upon the above principle: the heated rarefied land air rises, and its place is supplied by the chill damp air from the surface of the sea; that from the hills in the neighbourhood becoming cold and dense, in the course of the night, descends and presses upon the comparatively lighter air over the sea, and hence the land breeze. Granting that the attraction of the moon, and the diurnal movement of the sun, affects our atmosphere, there cannot be a doubt but a westward motion of the air must prevail within the boundaries of the trade winds, the consequence of which is an easterly current on each side: from this then it proceeds that south-west winds are so frequent in the western parts of Europe, and over the Atlantic ocean. Mr. Kirwan attributes our constant south-west winds, particularly during winter, to an opposite current prevailing between the coast of Malabar and the Moluccas at the same period: this, he adds, must be supplied from regions close to the pole, "which must be recruited in its turn from the countries to the south of it in the western parts of our hemisphere."

The variable winds cannot be so readily accounted for, yet it is evident that, though they seem the effect of capricious causes, they depend upon a regular system, arranged by the great author of nature. That accurate and successful observer of part of his works, the celebrated Franklin, discovered in 1740, that winds originate at the precise point towards which they blow. This philosopher had hoped to observe an eclipse of the moon at Philadelphia, but was prevented by a north-east storm, that commenced at seven in the evening. This he afterwards found did not occur at Boston till eleven; and upon enquiry, he had reason to suppose it passed to the north-east at the rate of about 100 miles an hour. The manner in which he accounts for this retrograde proceeding is so satisfactory, that we shall give it in his own words, particularly as his assertions are supported by recent observations both in America and Scotland. He argued thus: "I suppose a long canal of water, stopped at the end by a gate. The water is at rest till the gate is opened; then it begins to move out through the gate, and the water next the gate is first in motion, and moves on towards the gate; and so on successively, till the water at the head of the canal is in motion, which is last of all. In this case all the water moves indeed towards the gate; but the successive times of beginning the motion are in the contrary way, *viz.* from the gate back to the head of the canal. Thus, to produce a north-east storm, I suppose some great rarefaction of the air in or near the Gulph of Mexico; the air rising thence has its place supplied by the next more northern, cooler, and therefore denser and heavier air; a successive current is formed, to which our coast and inland mountains give a north-east direction." According to the observations made by Captain Cook, the north-east winds prevail in the Northern Pacific Ocean during the same spring months they do with us, from which fact it appears the cold air from America and the north of Europe flows at that season into the Pacific and Atlantic Oceans.

The remaining descriptions of winds may arise from a variety of causes. As the atmosphere has been ascertained to be composed of air, vapour, and carbonic acid and water, it is well known these frequently change their ærial form, and combine with different substances, and the reverse; consequently partial voids and accumulations must continually occur, which occasion winds of different degrees of violence, continuance, and of direction.

METOPE, in architecture. The spaces between the triglyphs in the frieze of the Doric order. They are sometimes richly sculptured; as in the temple of Minerva Parthenon at Athens.

METHOD, in botany, is a mode of arrangement from certain agreements or circumstances of resemblances. There are two kinds of methods in arranging vegetables, the natural, and the artificial: a natural method is that, which, in its distribution, retains all the natural classes; that is, such into which no plants enter that are not connected by numerous relations: an artificial method is that, the classes of which are not natural, because they collect together several genera of plants, which are not connected by numerous relations, although they agree in the characteristic marks assigned to that class to which they belong.

METHODISTS. The term Methodist was first given to Themison, the founder of a sect of physicians at Rome, which flourished about three hundred years, and had some of the greatest physicians of the age among its members.

In the seventeenth century there sprung up a new species of polemic doctors, who were denominated Methodists, and distinguished themselves by their zeal and dexterity in defending the church of Rome against the attacks of the Protestants. This sect is now no more; and the appellation is made to designate the followers of the late Messrs. John and Charles Wesley, and the societies founded by the Rev George Whitefield. They are divided into Whitefieldian and Wesleyan Methodists. The members of the former division embrace the doctrines of Calvin: the latter, as far as relates to Free-will, are Armenians. For an account of the doctrines held by the Whitefieldian Methodists, see article Calvinists.

The following are the doctrines held by the Arminians or Wesleyan Methodists: 1. Justification by Faith only; by which they mean, not only our acquittal at the last day, but present forgiveness, pardon of sins, and consequently acceptance with God.

2. They maintain, that the condition of justification is faith; and hold, that not only without faith no one can be saved, but also, that as soon as any one has true faith, in that moment he is justified: this is called the New Birth. It should be understood, that this doctrine of justification by faith only includes in it also the notion of the witness of the spirit: that is, according to the Methodists, an instantaneous, sensible impression, or "comfortable assurance," in the mind of the sinner, that his sins are forgiven, and that he stands justified before God; but on this part of the doctrine there appears to be a difference of opinion among them. At the conference held in 1806, Mr. Joseph Cooke was expelled from the connexion, because he had taught, in two sermons, which he published, "that in whatever moment a sinner returns to God, according to the requisitions of the gospel, God accepts that sinner, and his wrath no longer abides upon him; or, in other words, that the sinner is justified: and that, whether he has any comfortable persuasion of it in his own mind, or not." For this, though he offered to prove that he had taught nothing which is not contained in the writings of Wesley and Fletcher, Mr. Cooke was condemned unheard. "What," however, "he was not allowed to prove before the conference, he has since proved before the world." See his late publication, entitled "Methodism condemned by Methodist Preachers, &c."

3. They maintain, that though good works cannot go before, yet they must always follow, justifying faith.

4. They believe that it is the duty and privilege of all true believers to attain to a state of perfection, or, as they sometimes express it, entire sanctification, before they leave this life. This is a favourite doctrine with the Wesleyan Methodists. It is thus described: "they believe that Christians may, nay ought to, attain to a state of moral perfection before death; and that this may be attained in a moment, just as they received the forgiveness of their sins. This work they assign chiefly to the third person in the Trinity, who is said to commence his cleansing operations the moment he speaks peace to the soul by the absolution of the sinner; and that he, the Holy Ghost, silently, and sometimes almost imperceptibly proceeds

to work on the remains of inbred sin, till, in a moment, the old man with his deeds is wholly put off, and the soul is purged from every stain, not having spot or wrinkle, or any such thing. This state of perfection needs never be lost." Mr. Wesley asserted, that there is a state of sanctification, from which the believer can never fall. It is proper to remark, that the Methodists believe all the leading doctrines of other orthodox Christians, as far as relates to original or birth-sin, the Trinity, atonement, or the vicarious sacrifice of Christ, the eternity of hell torments, &c. They differ, however, from the Whitefieldian Methodists concerning predestination, irresistible grace, imputed righteousness, the final perseverance of the saints, election, and reprobation.

The Wesleyan Methodists are incorporated into a regular and compact body, and have adopted a system of church-government, which has a wonderful tendency to unite the members to each other. Their meetings for worship and for business are of various kinds, and are distinguished into prayer-meetings, class-meetings, band-meetings, watch-nights, love-feasts, yearly-covenants, quarterly-meetings, district meetings, and annual conferences. Their church officers are denominated travelling preachers, who are divided into superintendants and helpers; local preachers, who follow some secular employment, and never travel; class leaders, prayer leaders, or exhorters; band leaders, trustees, and stewards. For the more easy management and union of the whole connection, the kingdom is divided into districts, comprehending generally three, four, or more circuits, the whole being under the immediate superintendance of the conference, which is assembled annually, and consists of one hundred travelling preachers, at first nominated in the will of the late Rev. John Wesley, their numbers being regularly filled up by ballot.

Soon after the death of Mr. John Wesley, his people began to be divided with respect to discipline. Notwithstanding his professed attachment to the church of England, he suffered himself, towards the latter part of his life, to be persuaded to ordain some of his preachers bishops and priests! this produced a great sensation throughout the societies: and it was thought that he wished a regular ordination to take place at some future opportunity. At the first conference after his death, the preachers published a declaration, in which they avowed their determination to "take up the *plan* as Mr. Wesley had left it." This was by no means satisfactory to many of the junior preachers and people. Several pamphlets were published, tending to demonstrate the justness of the claim, that a plan of perfect equality and religious liberty ought to be extended to all the societies. These disputes at length produced what was called a *plan of pacification*, in which it was decided—by ballot! that in every place where a three-fold majority of class-leaders, stewards, and trustees, desired it, the people should have preaching in church-hours, and the sacrament of baptism and the Lord's Supper administered to them.

The spirit of investigation being excited, did not terminate here; for it soon began to be discovered that the people ought to have a voice in the temporal concerns of the societies, vote in the election of church-officers, and give their suffrages in spiritual concerns. Numerous pamphlets were published on these subjects. The leading man on the side of the people, was the late Mr. Alexander Kilham, who had been many years a travelling preacher, and was much respected for his zeal and activity in the cause of religious liberty. He was expelled the connection for publishing a work, intitled "The Progress of Liberty among the People called Methodists."

At the Leeds conference in 1797, there were delegates from many societies, in various parts, who were instructed to request, that "the people might have a voice in the formation of their own laws, the choice of their own officers, and the distribution of their own property." Their requests were refused; and a motion that delegates from the people might be permitted to have seats in the yearly conference being negatived, all hopes of accommodation between the people and the leading preachers were cut off. Immediately a new plan of church-government was proposed, and on it was founded a system of Methodism, denominated The New Connection. This plan was organized and supported by Mr. William Thom, an old travelling preacher, Mr. Alexander Kilham, and Mr. John Grundell, a blind gentleman of considerable talents, and unimpeachable integrity.

The preachers and people of the new connection, sometimes called Kilhamites, are incorporated in all meetings for business. Their plan of church-government is laid down in a small pamphlet, intitled "General rules of the United Societies of Methodists in the New Connection."

The following is given as an accurate

statement of the number of preachers and people in the Wesleyan connection of Methodists, at the close of the sixty-third annual conference, held in August, 1806:

In Great Britain	110,803
In Ireland	23,773
Gibraltar	40
Nova Scotia, New Brunswick, and Newfoundland	1,418
West India—Whites 1,775 Coloured people, &c. 13,165	14,940
United States–Whites 95628 Coloured people, &c. 24,316	119,944
Total	270,918

In addition to these may be added about 109,000 adult hearers—Methodists in religious sentiment; though, from various causes, prevented from formally joining the societies. To these still further may be added about 218,000 more, composed of the younger branches of families, and those generally influenced by the Methodist doctrines. About 6,000 more may be added, from Methodists, who, from slight difference as to discipline, &c. have formed themselves into independent societies, in various parts of the United Kingdoms; not now to reckon the Methodists of the New Connection. It appears from the report of the last conference, held at Liverpool, in July, 1807, that an increase of 8,492 members had then been made to the society in these kingdoms since the preceding conference. At the conference held by the Methodists of the New Connection, in May, 1807, their number was 6,428. They have had an increase, we understand, of about 700 since that period. It appears, therefore, that the total number of Arminian methodists amount to about 619,538. The Calvinian Methodists are doubtless equally numerous. The local and travelling preachers, belonging to the different Methodist societies, amount to about 1,630. For a very impartial and minute history of the rise and present state of this sect, see the Rev. J. Nightingale's "Portraiture of Methodism." Two pamphlets on the subject of Methodism have also been lately published, which have excited considerable interest, and deserve to be generally circulated, entitled "Hints to the Public and the Legislature, on the Nature and Effects of Evangelical Preaching." By a Barrister. Replies to the first of these pamphlets have been published by Dr. Hawker and others. The periodical publications conducted by the Methodists are numerous, and have an astonishing circulation. Of the Methodist Magazine about twenty thousand copies are sold monthly; of the Evangelical Magazine about twenty-two thousand. The sale of the Eclectic Review, in the same interest, appears, by a circular letter lately printed, signed by several preachers both of the Arminian and Calvinian Methodists, to be very limited. The Methodists have also in their interest a weekly newspaper, called "The Instructor." The number of small tracts and pamphlets sold and given away by the Methodists is incredible; and they are indefatigable in their attempts to convert the Mahometans and the Heathen to their way of thinking.

METRE, in poetry, a system of feet of a just length.

The different metres in poetry are the different manners of ordering and combining the quantities, or the long and short syllables; thus hexameter, pentameter, iambic, sapphic verses, &c. consist of different metres or measures.

In English verses, the metres are extremely various and arbitrary, every poet being at liberty to introduce any new form that he pleases. The most usual are the heroic, generally consisting of five long and five short syllables, and verses of four feet, and of three feet, and a cæsura, or single syllable.

The ancients, by variously combining and transposing their quantities, made a vast variety of different measures, by forming spondees, &c. of different feet. See Foot.

METROSIDEROS, in botany, a genus of the Icosandria Monogynia class and order. Natural order of Myrti. Essential character: calyx five-cleft, half superior; petals five; stamina very long, standing out; stigma simple; capsule three-celled. There are thirteen species, of which M. hispida is a very magnificent plant, easily distinguished by its broad, sessile leaves, and hispid branches; the flowers are yellow, with wide spreading stamens growing in umbels, many of which unite to form a large terminating corymb, rough, with red-brown hairs. This plant is common in most collections about London: it has not yet flowered. It was found at Port Jackson, in New South Wales, by Mr. White.

MEZZOTINTO, a particular manner of representing figures on copper, so as to form prints in imitation of painting in Indian ink.

The manner of making mezzotintos is

very different from all other kinds of engraving and etching, since, instead of forming the figures with lines and scratches made with the point of a graver, or by means of aquafortis, they are wholly formed by scraping and burnishing. Mezzotintos are made in the following manner: take a well-polished copper-plate, and, beginning at the corner, rake or furrow the surface all over with a knife or instrument made for the purpose, first one way, and then the other, till the whole is of a regular roughness, without the least smooth part to be seen; in which state, if a paper was to be worked off from it at the copper-plate press, it would be all over black. When this is done, the plate is rubbed over with charcoal, black chalk, or black lead, and then the design is drawn with white chalk, after which the outlines are traced out, and the plate finished by scraping off the roughness, so as to leave the figure on the plate. The outlines and deepest shades are not scraped at all, the next shades are scraped but little, the next more, and so on, till the shades gradually falling off, leave the paper white, in which places the plate is neatly burnished.

By an artful disposition of the shades and different parts of a figure on different plates, mezzotintos have been printed in colours, so as nearly to represent very beautiful paintings.

MICA, in mineralogy, a species of the Clay genus, is commonly of a grey colour, passing into brown and black. It occurs disseminated in thin tables and layers in other stones, also crystallized. It feels smooth, but not greasy. Specific gravity about 2.8 or 2.9. It may be converted by the blow-pipe into a white enamel, and it consists, according to Kirwan, of

Silica	38
Alumina	28
Oxide of iron	14
Magnesia	20
	100

By an analysis of Vauquelin, the difference is very considerable, as will be seen.

Silica	50
Alumina	35
Oxide of iron	7
Magnesia	1.35
Lime	1.35
	94.68
Loss	5.32
	100

Mica is one of the constituent parts of granite, gneiss, and mica-slate; it is also found in syenite, porphyry, and wacce, in almost every part of the world. It was formerly used for windows and lanterns, instead of glass, and in the Russian navy it is still used for the same purpose, being, on account of its elasticity, less liable to break than glass, on the discharge of cannon. Mica, used by the Russians, is dug up in Siberia.

MICHAUXIA, in botany, so named in memory of Andrew Michaux, botanist; a genus of the Octandria Monogynia class and order. Natural order of Campanaceæ. Campanulaceæ, Jussieu. Essential character: calyx sixteen-parted; corolla wheel-shaped, eight-parted; nectary eight-valved staminiferous; capsule eight-celled, many-seeded. There is but one species, *viz.* M. campanuloides, rough-leaved michauxia: this is a handsome biennial plant, having the habit of a campanula; it has a simple stem, panicled when in flower; upright, herbaceous, rough-haired, green, two feet high; root-leaves petioled, cordate; stem-leaves half embracing, lanceolate; flowers in a pannicle, peduncled, bracted, hanging down. It is a native of Aleppo.

MICHELIA, in botany, so named in honour of Pietro Antonio Micheli of Florence: a genus of the Polyandria Polygynia class and order. Natural order of Coadunatæ. Magnoliæ, Jussieu. Essential character: calyx three-leaved; petals fifteen; berries many, four-seeded. There are two species, natives of the East Indies.

MICROMETER, an instrument usually fitted to a telescope, in the focus of the object-glass, for measuring small angles or distances, as the apparent diameter of the planets. The general principle of this instrument is, that it moves a fine wire, parallel to itself, in the plane of the picture of an object, formed in the focus of a telescope, and thus measures its perpendicular distance from a fixed wire in the same plane.

This instrument was invented about the year 1666; and it has, of course, undergone many improvements since that time. Dr. Gascoigne divided the image of an object, in the focus of the object-glass, by the approach of two pieces of metal, ground to a very fine edge; instead of which, Dr. Hook would substitute two fine hairs, stretched parallel to each other: and two other methods of Dr. Hook, different from this, are described in his posthumous works. An account of several curious observations which Mr. Gascoigne made by the help of his micrometer, particularly in measuring the diameter of the moon and other planets, may be seen in the Philosophical Transactions, vol. xlviii.

De la Hire, in a discourse on the æra of the inventions of the micrometer, pendulum clock, and telescope, read before the Royal Academy of Sciences in 1717, makes M Huygens the inventor of the micrometer. That author, he observes, in his "Observations on Saturn's Ring, &c." published in 1659, gives a method of finding the diameters of the planets by means of a telescope, *viz.* by putting an object, which he calls a virgula, of a size proper to take in the distance to be measured, in the focus of the convex object glass: in this case, says he, the smallest object will be seen very distinctly in that place of the glass. By such means, he adds, he measured the diameter of the planets, as he there delivers them.

De la Hire says, that there is no method more simple or commodious for observing the digits of an eclipse, than a net in the focus of the telescope. These, he says, were usually made of silken threads; and for this particular purpose six concentric circles had also been used, drawn upon oiled paper; but he advises to draw the circles on very thin pieces of glass, with the point of a diamond. He also gives some particular directions to assist persons in using them. In another memoir, he shews a method of making use of the same net for all eclipses, by using a telescope with two object-glasses, and placing them at different distances from each other.

M. Cassini invented a very ingenious method of ascertaining the right ascensions and declinations of stars, by fixing four cross hairs in the focus of the telescope, and turning it about its axis so as to make them move in a line parallel to one of them. But the later improved micrometers will answer this purpose with greater exactness. Dr. Maskeline has published directions for the use of it, extracted from Dr. Bradley's papers, in the Philos. Trans. vol. lxii.

Dr. Derham tells us that his micrometer is not put into a tube, as is usual, but is contrived to measure the spectres of the sun on paper, of any radius, or to measure any part of them. By this means he can easily, and very exactly, with the help of a fine thread, take the declination of a solar spot at any time of the day; and, by his half-seconds watch, measure the distance of the spot from either limb of the sun.

J. A. Segner proposed to enlarge the field of view in these micrometers, by making them of a considerable extent, and having a moveable eye-glass, or several eye-glasses, placed opposite to different parts of it. He thought, however, that two would be quite sufficient, and he gives particular directions how to make use of such micrometers in astronomical observations.

A considerable improvement in the micrometer was communicated to the Royal Society, in 1743, by Mr. S. Savary; an account of which, extracted from the minutes by Mr. Short, was published in the Philos. Trans. for 1753. The first hint of such a micrometer was suggested by M. Roemer in 1675: and M. Bouguer proposed a construction similar to that of M. Savary in 1748. The late Mr. Dolland made a further improvement in this kind of micrometer, an account of which was given to the Royal Society by Mr. Short, and published in the Philos. Trans. vol. xlviii. Instead of two object-glasses he used only one, which he neatly cut into two simi-circles, and fitted each semi-circle in a metal frame, so that their diameters sliding in one another, by means of a screw, may have their centres so brought together as to appear like one glass, and so form one image; or, by their centres receding, may form two images of the same object: it being a property of such glasses, for any segment to exhibit a perfect image of an object, although not so bright as the whole glass would give it. If proper scales are fitted to this instrument, shewing how far the centres recede, relative to the focal length of the glass, they will also shew how far the two parts of the same objects are asunder, relative to its distance from the object-glass; and consequently give the angle under which the distance of the parts of that object are seen. This divided object-glass micrometer, which was applied by the late Mr. Dolland to the object end of a reflecting telescope, and has been with equal advantage adapted by his son to the end of an achromatic telescope, is of so easy use, and affords so large a scale, that it is generally looked upon by astronomers as the most convenient and exact instrument for measuring small distances in the heavens. However, the common micrometer is peculiarly adapted for measuring differences of right ascension and declination of celestial objects, but less convenient and exact for measuring their absolute distances; whereas the object-glass micrometer is peculiarly fitted for measuring distances, though generally supposed improper for the former purpose. But Dr. Maskelyne has found that this may be applied with very little trouble to that purpose also; and he has furnished the directions necessary to be followed when it is used in this manner. The addition requisite for this purpose is a cell, containing two wires, intersecting each other at right angles, placed in the focus of the eye-glass of the telescope, and moveable round about by the turning of a button. For the description of this apparatus, with the method of applying and using it, see Dr. Maskelyne's paper on the subject, in the Philos. Trans. vol. lxi.

After all, the use of the object-glass micrometer is attended with difficulties, arising from the alterations in the focus of the eye, which are apt to cause it to give different measures of the same angle at different times. To obviate these difficulties, Dr. Maskelyne, in 1776, contrived a prismatic micrometer, or a micrometer consisting of two achromatic prisms, or wedges, applied between the object-glass and eye-glass of an achromatic telescope, by moving of which wedges nearer to or further from the object-glass, the two images of an object produced by them appeared to approach to, or recede from, each other, so that the focal length of the object-glass becomes a scale for measuring the angular distance of the two images. The rationale and use of this micrometer are explained in the Philos. Trans. vol. lxvii.

Mr. Ramsden has described two new micrometers, which he has contrived for remedying the defects of the object-glass micrometer. One of these is a catoptric micrometer, which, besides the advantage it derives from the principle of reflection, of not being disturbed by the heterogeneity of light, avoids every defect of other micrometers, and can have no aberration, nor any defect arising from the imperfection of materials, or of execution, as the great simplicity of its construction requires no additional mirrors or glasses, to those required for the telescope; and the separation of the image being effected by the inclination of the two specula, and not depending on the focus of lens or mirror, any alteration in the eye of an observer cannot affect the angle measured. It has peculiar to itself the advantages of an adjustment, to make the images coincide in a direction perpendicular to that of their motion; and also of measuring the diameter of a planet on both sides of the zero; which will appear no inconsiderable advantage to observers, who know how much easier it is to ascertain the contact of the external edges of two images than their perfect coincidence.

The other micrometer, invented and described by Mr. Ramsden, is suited to the principle of refraction. This micrometer is applied to the erect eye-tube of a refracting telescope, and is placed in the conjugate focus of the first eye-glass; as the image is considerably magnified before it comes to the micrometer, any imperfection in its glass will be magnified only by the remaining eye-glasses, which in any telescope seldom exceeds five or six times; and besides, the size of the micrometer glass will not be the 100th part of the area which would be required, if it were placed at the object-glass; and yet the same extent of scale is preserved, and the images are uniformly bright in every part of the field of the telescope. See Philos. Trans. vol. lxix.

In the Philos. Trans. for the year 1782, Dr. Herschel, after explaining the defects and imperfections of the parallel-wire micrometer, especially for measuring the apparent diameter of stars, and the distances between double and multiple stars, describes one for these purposes, which he calls a lamp micrometer; one that is free from such defects, and has the advantage of a very enlarged scale. In speaking of the application of this instrument, he says, "It is well known to opticians, and others, who have been in the habit of using optical instruments, that we can with one eye look into a microscope, or telescope, and see an object much magnified, while the naked eye may see a scale upon which the magnified picture is thrown. In this manner I have generally determined the power of my telescopes; and any one, who has acquired a facility of taking such observations, will very seldom mistake so much as one in fifty in determining the power of an instrument, and that degree of exactness is fully sufficient for the purpose.

"The Newtonian form is admirably adapted to the use of this micrometer, for the observer stands always erect, and looks in a horizontal direction, notwithstanding the telescope should be elevated to the zenith. The scale of the micrometer, at the convenient distance of 10 feet from the eye, with the power of 460, is above a quarter of an inch to a second;

and by putting on my power of 932, I obtain a scale of more than half an inch to a second, without increasing the distance of the micrometer; whereas the most perfect of my former micrometers, with the same instrument, had a scale of less than the 2000th part of an inch to a second.

"The measures of this micrometer are not confined to double stars only, but may be applied to any other objects that require the utmost accuracy, such as the diameters of the planets or their satellites, the mountains of the moon, the diameters of the fixed stars, &c."

We shall now give an account of a micrometer by Mr. Troughton, which is applied to the eye-piece of a telescope to measure exceedingly small angles, as the diameter of the heavenly bodies, &c. Plate Microscope, &c. fig. 6, is an orthography projecting endways; fig. 7, a section of the box containing the wires; and fig. 8, a section lengthways; the same letters, as far as they can, are used in all the figures. Figs. 6 and 8, A is an eye-tube containing a convex lens at each end, this slides in another tube, *d d*, so as to adjust the glass to distinct vision of the wires: the tube, *d d*, is screwed into another, *b b*, which is much larger; through this a thin long box, D D D, containing the wire, slides. The micrometer is screwed to the telescope by a male screw, *e e*, (fig. 8.) in the same piece with which is a circular plate, *f f*, cut all round with fine teeth; this plate fits against the flat bottom of the box, *b*, and turns round concentrically with it by means of a ring, *k*, fitting into a conical hole in the centre of the plate *f f*, and screwed to the box; a small endless screw, *h*, (fig. 6,) turning in two brass collars screwed to the box, *b*, works in the teeth cut round the plate, *f*, and by that means, when the milled head on the arbor of the endless screw is turned, it turns the eye-tube and box, D D, round, to bring it to any convenient position for measuring the angles required; the box containing the wires is shewn open in fig. 7, it containing two frames, *h h h*, and *l l l l*, one sliding within another, which moves in the box without lateral shake, yet fitted so as to slide easily backwards and forwards in the box, by the screws, *m* and *n*, in the same manner as the microscope in the upper part of the same plate; *o* and *p* are springs to counteract the screws and make the motion pleasant. A wire is stretched across the frame, *h h*, at right angles to its sides, and another of the same size is fixed across the slider, *l l l l*, exactly parallel to the former; a small quantity of the under side of the latter is cut away, and its wire is fixed to another plane to the wire of *h h h*, so that the wires can pass each other without touching, but as near as possible; when they are placed by their screws over each other, and viewed through the eye-tube, they appear but as one wire: the divided circle *x*, on the nuts of the screws are then slipped round, without the screw, to bring the first division on them to the index, *l*; the instrument is now adjusted for observing any angle; it is screwed to the telescope, and by the endles screw *h*, (fig. 6.) the micrometer is turned round so as to bring a fixed wire, *w*, which is perpendicular to the others, to cover the two objects; the two wires are then separated by turning either of the nuts, F, until the wires include the angle to be measured: the whole box (fig. 7.) of the micrometer slides through the tube, in the direction of its length, to follow any moving object. When the observation is completed, it is read off by a scale of notches in the box, (fig. 7.) determining the number of revolutions the screw has made, and the divisions pointed out on the circles, *x*; by the indexes, *l l*, the number of aliquot parts is denoted; the circular plate, *f f*, is divided into degrees, as shewn in fig. 6, and it is by this that the angle the line measured makes with the horizon is registered.

The circles are divided into 100 parts, and have no determinate value in angular measurement, but their value is determined experimentally by observing through the telescope; it is applied to the diameter of the sun, or any other body, whose angular measure has been previously and accurately determined by some other divided instrument, and from this the angle given by each observation is calculated.

The micrometer has not only been applied to telescopes, and employed for astronomical purposes, but there have been various contrivances for adapting it to microscopical observations. M. Leeuwenhoek's method of estimating the size of small objects, was by comparing them with grains of sand, of which one hundred in a line took up an inch. These grains he laid upon the same plate with his objects, and viewed them at the same time. Dr. Jurin's method was similar to this; for he found the diameter of a piece of fine silver wire, by wrapping it very close upon a pin, and observing how maay rings made an inch: and he used this wire in the same manner as Leeuwenhoek used his sand. Dr. Hook used to look upon the magnified object with one eye, while, at the same time, he viewed other objects, placed at the same distance, with the other eye. In this manner, he was able, by the help of a ruler, divided into inches and small parts, and laid on the pedestal of the microscope, as it were, to cast the magnified appearance of the object upon the ruler, and thus exactly to measure the diameter which it appeared to have through the glass; which being compared with the diameter, as it appeared to the naked eye, easily shewed the degree in which it was magnified. A little practice, says Mr. Baker, will render this method exceedingly easy and pleasant.

Mr. Martin, in his Optics, recommends such a micrometer for a microscope as had been applied to telescopes; for he advises to draw a number of parallel lines on a piece of glass, with the fine point of a diamond, at the distance of one-fortieth of an inch from one another, and to place it in the focus of the eye-glass. By this method Dr. Smith contrived to take the exact draught of objects viewed by a double microscope; for he advises to get a lattice, made with small silver wires or squares, drawn upon a plain glass by the strokes of a diamond, and to put it into the place of the image formed by the object-glass. Then, by transferring the parts of the object, seen in the squares of the glass or lattice, upon similar corresponding squares drawn on paper, the picture may be exactly taken. Mr. Martin also introduced into compound microscopes, another micrometer, consisting of a screw.

A very accurate division of a scale is performed by Mr. Coventry, of Southwark. The micrometers of his construction are parallel lines drawn on glass, ivory, or metal, from the 10th to the 10,000th part of an inch. These may be applied to microscopes for measuring the size of minute objects, and the magnifying power of the glasses; and to telescopes for measuring the size and distance of objects, and the magnifying power of the instrument. To measure the size of an object in a single microscope, lay it on a micrometer whose lines are seen magnified in the same proportion with it, and they give, at one view, the real size of the object. For measuring the magnifying power of the compound microscope, the best and readiest method is the following: On the stage, in the focus of the object-glass, lay a micrometer, consisting of an inch divided into 100 equal parts, count how many divisions of the micrometer are taken into the field of view; then lay a two-foot rule parallel to the micrometer: fix one eye on the edge of the field of light, and the other eye on the end of the rule, which move till the edge of the field of light and the end of the rule correspond; then the distance from the end of the rule to the middle of the stage will be half the diameter of the field. *Ex. gr.* If the distance be 10 inches, the whole diameter will be 20, and the number of the divisions of the micrometer contained in the diameter of the field is the magnifying power of the microscope.

Mr. Adams has applied a micrometer, that instantly shews the magnifying power of any telescope.

In the Philos. Trans. for 1791, a very simple scale micrometer, for measuring small angles with the telescope, is described by Mr. Cavallo. This micrometer consists of a thin and narrow slip of mother-of-pearl, finely divided, and placed in the focus of the eye-glass of a telescope, just where the image of the object is formed, whether the telescope is a reflector or a refractor, provided the eye-glass be a convex lens. This substance, Mr. Cavallo, after many trials, found much more convenient than either glass, ivory, horn, or wood, as it is a very steady substance, the divisions very easy marked upon it, and when made as thin as common writing paper, it has a very useful degree of transparency.

MICROPUS, in botany, a genus of the Syngenesia Polygamia Necessaria class and order. Natural order of Compositæ Nucamentaceæ. Corymbiferæ. Jussieu. Essential character: calyx calicled: ray of the corolla none: female, florets wrapped up in the calycyne scales; down none: receptacle chaffy. There are two species, *viz.* M. supinus, trailing micropus; and M. erectus; natives of Spain and the Levant

MICROSCOPE, in optics. By microscopes are understood instruments, of whatever structure or contrivance, that can make small objects appear larger than they do by the naked eye. This is effected by means of convex glasses. When only one convex glass or lens is used, the instrument is called a single microscope; but if two or more are employed constantly to magnify objects, it is then called a double or compound microscope. When objects are seen through a perfectly flat glass, the rays of light pass through it from them to the eye in a straight direction, and parallel to each other, and consequently the objects appear very little either diminished or enlarged, or nearer or further off, than to the naked eye. But if the glass through which they are seen has any degree of convexity, the rays of light are directed from the circumference towards the centre, in an angle proportionate to the convexity of the glass, and meet in a point, at a greater distance from the glass, as it is less or more convex. This point, where the rays meet, is called the focus, which is nearer or further off, according to the convexity of the glass; for a small degree of convexity throws it to a considerable distance; when the convexity is much, the focus is near. The magnifying power is in proportion to its convexity; for, as a flat glass magnifies scarcely at all, the less a glass departs from flatness, the less it magnifies; and the more it approaches towards a globular figure, the nearer its focus is, and the more its magnifying power. We shall refer to OPTICS for a more particular account of the principles, and proceed to describe some instruments of which we have made drawings. Plate Microscope, &c.

The body of the microscope, AA, being a large tube, is supported by brass pillars, *b b*, rising from a wooden pedestal, *c*, in which pedestal is a drawer to hold the object-glasses, and other parts of the apparatus; a lesser tube, *e e*, slides into the greater, and is moved up and down therein by a rack and pinion turned by a milled-headed nut, *t*; into this tube is pushed the body of the microscope, as shewn in the section fig. 1, and moving up and down with it; it has at its bottom another tube much smaller than itself, *f*, with a male screw, *g*, at the end thereof, whereon to screw the object-glasses, or magnifiers: there are five of these magnifiers, numbered 1, 2, 3, 4, 5, which numbers are also marked on the inner tube, *e e*, to direct where about to place it, according to the magnifier made use of; but if it does not fit the eye exactly, move the inner tube gently, higher or lower, by the nut *t*, till the object appears distinct. The greatest magnifiers have the smallest apertures, and the lower numbers. L, is a circular plate of brass, fixed horizontally between the three brass pillars, *b b*, and in the centre thereof a round hole. M, is adapted to receive a proper contrivance, fig. 4, for holding ivory sliders, wherein objects are placed, which contrivance consists of a spiral steel wire, confined between three brass circles, one whereof is moveable for the admission of a slider. Q, is a concave mirror set in a box of brass, and turning in an arch, R, upon two small screws. From the bottom of the arch comes a pin, which being let down into a hole in the centre of the pedestal, enables it to turn vertically or horizontally, and reflect the light either of a candle or the sky, directly upwards on the object to be viewed. V, is a plano-convex lens, which, by turning on two screws when the pin at the bottom of it is placed in the hole made for its reception in the circular plate L, will transmit the light of a candle, to illuminate any opaque object that is put on the round piece of ivory, or on ebony, for examination, and it may be moved higher or lower as the light requires: this glass is useful to point the sunshine, or the light of a candle, upon any opaque object; but in plain day light is of no great use. The brass fish pan, fig. 3, is to fasten a smelt, gudgeon, or any such small fish upon, to see the blood circulate in its tail; for which purpose, the tail of a fish must be spread across the oblong hole, or the end of the pan, by slipping the button on the backside of the pan, into a slit, through the circular plate, L; a spring that is beneath the plate presses the button, and will make it steady, and present it well; but if it be a frog, a newt, or eel, in which the circulation is desired to be shewn, a glass tube, fig. 6, is fittest for the purpose. The tail of a newt, or eel, or, in a frog, the web between the toe of the hind feet, are the parts where it may be seen best. When the object is well expanded on the inside of the tube, slide the tube along under the circular brass plate, L, where there are two springs, and a cavity made in the shank to hold it, and bring the object directly under the magnifier.

There are three of these glass tubes, smaller one than another, and the size of the object must direct which to use; but, in general, the less room the creature has to move about in, the easier it may be magnified, and the quieter it will lie to be examined. Three loose glasses, *viz.* one plain, and two concave, belong also to the microscope, and are designed to confine objects, or place them upon occasionally.

The long steel wire, fig. 7, (with a pair of plyers at one end, and a nob of ivory at the other, to hold fast, or lay objects on), slips backwards or forwards in a short brass tube, whereto a button is fastened, which fits into a little hole near the edge of the brass plate L, and then the object may be readily brought to a right position, and a light be cast upon it, either by the looking-glass underneath, or, if it be opaque, by the plano-convex lens, N.

L, fig. 4, is a flat piece of ivory, called a slider, with four round holes through it, and objects placed in them, between Muscovy talcs, or isinglass, kept in by brass wires.

It is proper to have a number of these sliders, filled with curious objects, always ready, as well as some empty ones, for any new thing that offers. When made use of, thrust them between the brass rings of the contrivance on purpose for them, as shewn in fig. 4, which shoots into the round hole M, in the centre of the brass plate, L; this keeps them steady, and, at the same time, permits them to be moved to and fro for a thorough examination.

The upper part of Plate Microscope, &c. describes the construction of a microscope, used for observing the divisions on mathematical instruments, and subdividing them into smaller portions. The drawing was made from one of those used by Mr. Troughton in his instruments; and the position of four of them are shewn in the drawing of one of his astronomical circles, see Circular Instrument, fig. 1, an elevation sideways of the microscope; fig. 2, a section, in the same direction; fig. 3, a section endways, and four and five parts shewn separately.

The microscope is fixed to the instrument it is applied to, by two nuts, *a a*, figs. 1 and 2, which work upon a male screw, cut on the external tube; these nuts have a smaller part turned upon them, which exactly fit into a circular hole in a piece of brass fixed to the instrument, and by screwing the nuts tight, the microscope is fixed, as shewn in the drawing of the astronomical circle before referred to. B, fig. 1 and 2, is the sliding tube containing two convex lenses, *b d*, fig. 2, whose combined foci fall upon the wires to be hereafter described; this tube slides in another, D, screwed into a thin, square box, E, which contains the wires and screw, and it is shewn opened in fig. 3; it has a square frame, fig. 5, sliding in it; to this is affixed a very fine screw, which comes through the top of the box, and has a nut, F, screwed on it; at *e*, within the box, is a spring formed of steel wire, acting upon the frame, fig. 5, so as to draw it into the box; by this the shoulder of the nut, F, is forced down upon the top of the box, and all shake or looseness in the motion prevented.

The frame has two exceedingly fine wires stretched across it, as in the figure, and it is by these the divisions on the instrument are observed; G is a conical tube, screwed into the principal tube of the instrument, with the object-glass at its end: the box, E, also contains a thin brass plate, fig. 4, which slides in it beneath the frame, fig. 5, and is moved when necessary by a small screw, *a*, going through the bottom of the box, whose action is counteracted by two thin slips of watch-spring, (seen in fig. 3;) this plate has an oblong hole through it to see through, and on one side it is out into fine notches, at such a distance apart that one turn of the nut F, when viewed through the eye-tube, moves the cross wires in the frame, fig. 5, exactly one of these notches, and by that means the notches register the number of revolutions the nut has made. In adjusting and adapting this microscope to any instrument, the sliding eye-tube, B, is to be slid in or out of the tube D, till the cross wires in the frame, fig. 5, are seen perfectly distinct. The microscope is then to be placed in such a position on the instrument it is applied to, that the line of divisions on the arc shall be parallel to the motion of the cross wires and frame, fig. 5, and screwed into its holder by the nuts *a a*, (as shewn in the drawing of the circle) and the focus is adjusted so as to see the divisions on the arc distinctly, by turning these screws backwards or forwards, and moving the whole microscope nearer to or further from the arc, until it is adjusted to distinct vision. The operator then looks through the microscope, and observes whether one division on the divided arc of the instrument answers to twenty of the notches of the scale, fig. 4, (which will each be then equal to one minute;) if not, the conical tube, G, containing the object-glass at its end, must be screwed in or out of the body of the microscope, until the image of the division or degree is lengthened or shortened till it does, and a loose nut on the tube holds it any place required; if this adjustment deranges the other before made for distinct vision, it must be rectified by the nuts *a a*, and if this alters the space measured by the scale, fig. 4, the object-glass must be altered, and then again the nuts, *a a*, first one and then the other, until both adjustments of measure and distinct vision are perfect. The small screw which gives motion to the scale, fig. 4, is used to adjust it to the point of commencement on the circle or divided arc; or when two opposite microscopes are applied to the same circle, to adjust them so that they shall both read alike, that is, so that a line between them shall pass through the centre of the circle, and for the same purpose the small divided circle, *x*, of the nut F, will slip round upon the nut when required, without turning the screw to bring the first division upon it to the index, *l*, when the cross wires coincide with the point of commencement of the circle or divided arc.

For reading the divisions by this microscope, the middle notch of the scale, fig. 4, is accounted the first, and every fifth is denoted by a longer notch, and every tenth by a still longer, instead of figures. If now, when the circle is set to its required position, and observed through the microscope, any division or degree on the circle exactly coincides with the middle or first notch on the scale, the reading will be even degrees; if the division on the circle does not match with the first notch on the scale, the nut, F, of the screw must be turned, until the cross wires in the frame, fig. 5, exactly coincide with the division on the circle; the number of notches on the scale denotes the minutes, and the number of the division on the small circle *x*, on the nut, F, which is opposite to the index, *l*, denotes the number of seconds. See Optics.

MICROTEA, in botany, a genus of the Pentandria Digynia class and order. Natural order of Oleraceæ. Atriplices, Jussieu. Essential character: calyx five-leaved, spreading; corolla none; drupe dry, echinated. There is only one species, *viz.* M. debilis, a native of the island of St. Christopher, in the West Indies.

MIDWIFERY. The art or science of assisting women in child-birth. Of late years, however, and especially in this country, since the Royal College of Physicians of London has consented to admit, into a distinct class of its licentiates, such as, upon examination, shall appear duly qualified for obstetric practice, it has become an art or science of more extensive range and embraces every case connected with the female sexual system, as well as diseases of infancy during the period of lactation. Such being the general signification assigned in the present day, we shall contemplate the term under this sense, except what relates to the diseases of Infancy, already considered under that article, in the following sketch of its rise, progress, and practice.

History.

The history of midwifery may be comprised in a few words. In the earliest ages of life, when the manners were simple, the hours of rest and food regular, and the general strength and health proportionate, it was only in cases of mal-conformation, either of the mother or of the child, or mispresentation of the latter, that any other assistance, perhaps, than what nature herself either gave or indicated, could be demanded. These exceptions, even in the present day of luxury, complex manners, and delicate health, are upon the whole extremely few, compared with the general average of births that every hour is a witness to. Yet, in the periods we are now contemplating, we know that they must have been very considerably fewer, because we know, that in every instance in which society, by its natural tendency, has overstepped the just medium of its prime object, and introduced soft and delicate habits, capricious fashions, and all the luxuries of refined life, it has at the same time introduced debility, even from birth, and often before birth, and consequently all those mal-conformations, and obliquities from the line of health, which naturally belong to mankind of both sexes, and which it is their own fault (we mean the fault of themselves or their ancestors) that they do not equally possess in every generation.

Hence the art of midwifery is coeval with civilized life, and is to be measured by its advance to the utmost summit of refinement. In the earliest ages, when nature required nothing more than mere co-operation with her common efforts, women alone, and these of no peculiar degree of skill, must have been altogether competent to the business of child-birth: and hence the midwives of the Hebrews, of the Greeks and Romans, we have reason to believe were all females; nor do we meet with a single instance of a chirurgical or medical practitioner having been had recourse to and actually employed earlier than the middle of the seventeenth century. Perhaps, among the earliest practitioners on the continent, we may mention M. Julian Clement, a surgeon of high reputation at Paris, who attended in a difficult case, Madame de Valiere, in 1663 and Dr. William Harvey among those of our own country, who published his celebrated treatise on generation a few years antecedently, and a few years afterwards engaged in the practice of midwifery, and followed up his practice with his *Exercitatio de partu*.

There can be no doubt that midwifery ought to have been studied and practised scientifically many ages before the period at which we have now arrived, and that thousands of lives, as well of mothers as of children, must have fallen a sacrifice to the want of anatomical skill and knowledge upon this subject. Luxury, extravagance, and dissipation, were as common at Athens and Rome, during some periods of their history, as they have been in any part of Europe during the last two centuries; and though it is probable that the Athenian and Roman matrons did not, from the fashion of their respective eras, run quite so readily as the ladies of the present day into all the excesses of men, yet there can be no doubt that the example was contagious, and that the result, in regard to debility of frame, and consequently occasional mal-conformation of organs, if not equal in point of frequency and degree, could not have essentially varied. And in reality, had the Greek and Roman ladies been as correct and regular as possible in their own lives, yet, from the necessity they must have been too frequently under of intermarrying with men of far less correctness and regularity, the female offspring hence ensuing could not fail to inherit much of the same kind of delicacy and debility of frame, and consequently misproportion of construction, which we too frequently witness in the present day.

Still, however, it was the fashion to employ women, and none but women, in the momentous process of child-birth, notwithstanding the necessity of a contrary practice. Natural modesty, not always in league with fashion, gave additional force to the general custom, and imperious as was the call for the occasional employment of persons, who had been regularly taught at the schools of anatomy, and had hence acquired a scientific knowledge of the organs concerned in gestation and labour, and of the changes they undergo during these respective processes,—life was in general rather to be sacrificed, than a male practitioner of surgery to be resorted to. That the call for such assistance was imperious, we could adduce a thousand instances to prove, if it were necessary; we shall only observe, that Agnodice, a scholar of Hierophilus, in order to acquire a knowledge of this branch of anatomy, and finding herself prohibited, either by the common law of custom, or the written law of the state, from acquiring such knowledge in her own sex, consented to assume a male appearance, and for this purpose cut off her hair, exchanged her female for male attire, and in this disguise attended the lectures of this celebrated physician. She then publicly entered upon her profession; but another difficulty occurred to her, which was, that, from the dress and appearance she had so long assumed, she was still suspected to be a man, notwithstanding she had returned to the common dress of her sex; and it was long before the prejudice thus excited was completely overcome.

On these accounts, the art of midwifery made less improvement than any other branch of medicine. Hippocrates says but little on the subject; and that little but very little to the purpose. He appears to have known of no other method of delivery, than by a presentation of the child's head; if any other part presented, he advises such part to be turned, and this not by an introduction of the hand of the practitioner into the uterus, but by shaking the mother, by making her jump repeatedly, or by rolling her on her bed; and if this do not succeed, to destroy the child, and deliver it piece-meal. In the writings of Celsus, however, who flourished during the reign of Tiberius, we find hints that prove some advance had been made towards a more humane, scientific, and successful practice; for we are here told, that children may be safely and easily delivered in presentations of the feet as well as of the head, by taking hold of the legs, and dragging them downwards; as also, that if any other parts present than the head or feet, the child must be turned in the uterus by the introduction of the assistant's hand, so that one or the other of these organs be brought forwards into the vagina. We also meet with another piece of advice, which we are sorry to perceive has been of so long standing in the world, and which is very injudiciously praised and practised in the present day: and that is, that the practitioner ought to be perpetually striving to dilate the os tincæ, or orifice of the womb, by the introduction of the fore finger alone, when the opening is only large enough to admit a single finger, smeared over with lard or pomatum; and that he should continue progressively to introduce two, three, or more fingers, and at length the whole hand as a general dilator to the orifice, so that the head, or whatever other part of the child presents, may the more readily pass through. Now it is comparatively very seldom that any benefit can be derived from this perpetual tampering; in some few cases of relaxed uteri, where the orifice is sufficiently enlarged to allow three or four fingers to enter at once, and the pains at the same time are but feeble, or at least have but a small propulsive power, some advantage may be obtained; but none in any instance where the orifice is not large enough to admit of more than a single finger; while in every such attempt, provided the uterus be rigid and unpliable, instead of facilitating the enlargement, the practitioner will considerably obstruct it, his perpetual stimulus continually thickening and indurating the edges of the orifice.

Yet delivery by the feet appears by no means to have been approved by the profession in general. Celsus, though an admirably well informed man and an excellent writer, was not of the profession, while Galen, who was of it, condemned the practice as decidedly as Hippocrates. In reality we meet with the same kind of general condemnation as late as to the middle of the seventeenth century; for Riverius censured it publicly in 1657, and though Mauriceau inclined to it in his own practice, as he informs us in his "Treatise on Midwifery," published in 1664, he tells us, at the same time, that many authors were of opinion, that in all foot-cases it would be better to attempt to turn the child, than to deliver with such a presentation. So slow is the world to shake off a prejudice of any kind, when once deeply rooted, however unfounded, or even fatal.

About this period several tracts or treatises on midwifery in Great Britain, issued from the pens of Wharton, Charleton, Mayow, and Raynold, of all which the last appears to have been the most celebrated writer. To the instrument called the crotchet, which had long been in use, but most commonly for removing the mangled limbs of the child, whom it was thought necessary to destroy, we now find added, generally supposed to have been an invention of Chamberlen, a forceps, of a peculiar kind, having a near resemblance to what is now denominated a vectis. The employment of male practitioners grew common, books of real science, and containing information of the most valuable description, issued freely from the press, and especially from the labours of Chamberlen, Willoughby, Bramber, and Simpson; lectures of reputation upon the subject of midwifery were instituted, and largely attended, a variety of ingenious instruments were devised and multiplied, and the first public description of the modern forceps was given by Chapman, the second public teacher of midwifery in London, which made its appearance in the third volume of the Edinburgh Medical Essays. It is useless to pursue this narrative any farther; the names of Smellie, Hamilton, Orme, and Denman, are known to every one; and their instructions have been widely felt, and duly appreciated, not only by the profession, but by the world at large.

DISEASES OF THE FEMALE SEXUAL SYSTEM.

From a cause that has never yet been explained, women, on the commencement of puberty, throw forth, at monthly intervals, a peculiar and coloured fluid from the uterus; which terms of discharge only cease, or only should cease, during pregnancy, and lactation, till the age of about forty-five in this country, and others of a similar warmth, though the age at which it ceases is much earlier in countries of greater heat, and where the general form acquires a much earlier maturity. At the commencement of this natural or regular flow, which is usually denominated menses or menstruation, women are often subject to many diseases, from the change that takes place in the constitution at that period. They are subject to other diseases from a morbid suppression, or too large or too frequent an evacuation of this discharge; and again to others, at the period of its final termination.

We shall first examine into the nature of the menstrual fluid itself. It was formerly supposed that this fluid was a kind of surplus blood thrown out of the system from the mouths of minute veins. It has been clearly ascertained, however, by Dr. W. Hunter, that this fluid, whatever it be, is thrown from the mouths, not of the uterine veins, but the uterine arteries; and that, instead of being blood, it has scarcely any one property in common with blood, excepting indeed in its colour. Generally speaking, the average time the discharge continues is three or four days; and as to the proportional quantity lost on each day, on the first and fourth, or on the third day, the woman loses a fourth of the whole quantity each day, and, on the middle day, about the other half. The quantity lost will generally be three or four ounces altogether, a single ounce on the first day, two on the second, and the fourth and last ounce on the third day. There is nothing, however, more affected by the climate than this: in a warm climate the quantity being increased, while it is diminished in cold ones Linnæus, while writing his account of Lapland, says, that the quantity lost there is never above half an ounce or an ounce. In hot islands, as in those of the Archipelago, Hippocrates writes, that the women lose twenty ounces of blood by this evacuation. Artificial warmth promotes the menstrual flux as powerfully as that of the sun.

The discharge, as we have already observed, commences with puberty, which varies exceedingly from climate. In Persia the females are fit for all the purposes of women at ten years old. In Lapland not till twenty. In our country about sixteen; and this period is characterized by certain attendant circumstances: the age of puberty is evinced by hair growing on the pubes and in the axillæ; the breasts are formed and made perfect; there is also a change in the ovaria.

The discharge when it earliest appears is not at first red, generally it is without colour. The succeeding periods are very regular, being every month, unless the woman lives in a state of nature, and falls with child, when, upon a pretty accurate calculation, she will menstruate about once in twenty months, if she suckle. Menstruation having begun will go on regularly, unless interrupted by disease, or pregnancy, for a great number of years, generally till between the fortieth and fiftieth year; and the time of its cessation is generally regulated by the age at which it commenced The final cessation of the menses may be known to be advancing by certain irregularities in the appearance: instead of the discharge lasting three, it will continue for ten days; nothing will then be seen for two months; next it may come once a fortnight, and then profusely. Menstruation appears to be a discharge intended to preserve the uterus in a state fitted for conception, for a girl cannot conceive till after the menses have appeared; nor does any woman conceive after they have ceased to flow.

So that women only can become pregnant while the menses continue; and they appear to be more susceptible of conception immediately before and directly after them, than at any other part of the month. Also, in all animals, there is a discharge somewhat analogous to it, which in them is called heat. This state is very nearly allied to it; and is well understood by boys, not one of whom, when buying a doe-rabit, will pay half the price for it, if not in heat, as if she be in heat; he has nothing to do, but, by pressing with his thumb, to invert a portion of the vagina, and if it be red and covered thickly with blood-vessels, he knows it indicates heat, and is what he looks for; but if the vagina be smooth and white, every boy knows that he must keep that rabbit on bran and other expensive provisions for a month, before she will take the buck.

Menstruation may be the subject of disease from irregularity, obstruction, excess, or painful extrusion.

Irregular Menstruation. This may regard its time of accession or cessation. It may be irregular in its monthly return; or as to the quantity of fluid lost at each period; it may arise too early in life, or continue too late. The first consideration is where it arises too early in life; perhaps, however, there is no such thing as menstruation beginning too early in life, except as connected with a complaint. It may arise from too great strength of constitution and vascular action; from increased fulness of vessels, depending on too large a quantity of animal food for the wear and tear of the constitution. There is a full face; a full pulse; a throbbing in the head; the breasts are full, with a warm imagination. This secretion arises properly at sixteen; but here it begins at twelve or thirteen. As in this case it arises from too much blood, we should take some away; prescribe purges and strong exercise; but the medicine must be chosen. Rhubarb, jalap, senna, colocynth, and aloes, are not calculated to diminish the quantity of blood; they only increase the peristaltic motion of the intestines. Saline purgatives should be preferred, and a spare diet must be insisted upon.

The other state of the menses is where they stay too late; this is more common than the preceding affection, and more especially in large towns. It occurs where there is too little blood, and the uterus is not in a state fit for conception. The pulse is weak, the appetite disordered, the countenance pale, the constitution below par in point of strength. We will now consider both the states just described. The first will be liable to sudden inflammation of the lungs, and has that state of body which predisposes to what is called a galloping consumption. The other will generally be more or less a scrophulous habit, disposed to go into a decline or slow consumption. Here the mode of treatment adopted in chlorosis may be superadded to that for the restoring health by sea-bathing, if the lungs be not any way affected, and the stomach in good order, but not where there is a weak stomach or oppressed respiration.

Of Amenorrhœa, or obstructed Menstruation. Of this there are two kinds; one the acute, or accidental; the other the chronic. The acute, or accidental, arises where there is perfect health up to the time of menstruating, and the patient takes cold at the point of discharge, or even while menstruating, and the flow is prevented, or suddenly ceases.

Obstructed menstruation generally depends upon the application of cold; this will produce a fever which will stop it, if coming on, and arrest its progress, where it has already commenced. In all such cases there is pain in the head, back, and loins, pain in the limbs, with all the symptoms marking fever. If we know of this early, we may with ease give relief. We may always take away blood, and clear the bowels; rhubarb is the best medicine; then a saline draught, with antimonials in such quantity as to come short of vomiting, and five or six drops of laudanum, or four or five grains of ipecacuanha every six hours. The warm bath is productive of advantage, where applied soon after the complaint has begun. Where the slipper bath is not at hand, the lower part of the body may be seated in a volume of tepid water in a large tub, or the convenient vehicle called a hip bath; after which the patient must be made very dry, and put into a warm bed, and use the remedies before mentioned; and the discharge will return, or, if not immediately, it will ultimately return, and the health remain unimpaired: but, if the menstruating period be passed over, it then becomes a chronic obstruction, the symptoms attending which are very destructive of female health.

Of the chronic obstruction of menstruation there are also two kinds, which have each a distinct set of symptoms; those of plethora, and those of weakness; and chronic obstruction, depending on plethora, may degenerate into that kind depending on weakness. The patient will first be taken with symptoms which only belong to plethora, and after that arise those belonging to weakness. The young are most liable to the first kind, in whom the quantity of blood is much increased beyond what it should be, by luxurious habits, and where too little exercise is taken for the quantity of food; and even here it will not often lead to obstruction, unless the occasional cause is applied by taking cold: when this does really happen, the attack of fever may be so slight as not to be observed by the patient. Where we see all the signs of the system being loaded with blood, we should certainly take some away: where the pulse is hard, full, strong, and frequent; the skin dry and hot, more thirst than there should be, with pain in the head, back, and loins: where, especially, instead of an active disposition, we see a desire to be always by the fire, and the girl at the same time liable to giddiness. Here the pulse is nearly up to 100, which being an increase of more than twenty beats in every minute, the effects of such increased action is, that the strength will be worn out, and the chronic obstruction from plethora be changed into the chronic obstruction from weakness; the reason is this, that the action is so strong that it may, by continuing, exhaust the powers of life; nothing indeed exhausts the strength of the system so much as increased action of the heart and arteries: for it is not the pulsating arteries alone that are affected, but in the same proportion is the action of all the capillary vessels in the body increased, so that the whole extent of increased action is prodigious. It being known that the action arising from obstructed menstruation with plethora brings on weakness, it might be expected that the strength of action would be brought gradually down to the point of health; but that never happens; it sinks below it. This sort of obstructed menstruation must be treated by evacuation, by bleeding; but the foot is not preferable, as we do not get blood enough by opening the vena saphena, unless the foot be immersed in warm water; and if this be done, we are unable to tell the quantity we take, unless we from time to time measure the water. The best way, then, is to bleed from the arm, and with bleeding to use purgative medicines; the patient should take much exercise and little sleep, and, on the intermediate day to those on which we give the purgatives, we should give saline draughts. The effect of this will be, that she will be brought down from great and morbid action to the state of health; and it is fifty to one but the menstrual discharge returns immediately.

This species of chronic obstruction proceeds from plethora, and plethora may exist so as to prevent menstruation, either at its earliest effort, or after it has been long in the regular habit of recurring.

The term chlorosis is generally applied to the first kind; amenorrhœa to the second: but chlorosis, or green-sickness, is a mere result, and may result from either; it is that chronic menstruation depending on symptoms of weakness we have already noticed, and may result from each, as well as from a distinct and separate source, because the continued action of vessels exhausts the strength. Usually, however, the complaint depends on improper food, living in bad air, or want of exercise, and, added to these, want of communication between the sexes; for a certain state of the ovaria predisposes to it. One symptom in this kind of obstructed menstruation is, there being a mark perceived round the ancle at night where the edge of the shoe reaches; another is, a fulness and puffiness of the face and eyelids in the morning; so that, after sleep, the whole countenance looks too big; while in the course of the day this size and appearance goes entirely off. These last effects are evidently those of œdema, because during the day the water lodged in the cellular substance about the face subsides, and the cells below are progressively filled; so that by night the ancles are swelled: during the night again, the gravitation of the fluids diffuses the appearance of swelling over the face.

The upper extremities partake at last in this appearance, becoming swelled about the hands at night. In short, the whole skin is swoln and stretched, and assumes a soft pappy feel. To these symptoms there is now added a very great derangement of stomach, the appetite goes quite away; sometimes the patient has an inclination for improper food, a vehement fondness for cinders, candles, or pipe-clay; this does not seem to belong to any sort of instinctive impulse from nature, but depends on a derangement of stomach alone: all these evidences are further proved by flatulency, and a sense of weight at the stomach after eating; great irregularity of the intestines, sometimes costive, and at others lax; vegetables undergoing their acid fermentation, and animal matter its putrefaction; both known by eructation, both dependent on the impaired state of the stomach: to these succeed difficult respiration, either on walking or going up stairs; and this does not arise from ordinary weakness, where a person could rest, because she was tired; but in chlorosis, she stops because she loses her breath: with this there is palpitation at the heart; the pulse is frequent, small, and hard; and there are hysterical symptoms, very often, where the obstruction has been of long continuance. This complaint, however, is easily cured where it has been of short duration, and the menstruation is not permanently interrupted.

The *treatment* will depend on the form which all the symptoms take on, when combined. Though cases of this obstruction differ from ordinary weakness, yet the treatment we should pursue will be applicable to most cases of weakness. It is right to keep the bowels clear, by an occasional dose of rhubarb; we should then begin the use of bitter medicine, remembering that, in proportion as the weakness is greater, the medicine should be weak; for it is an error to suppose that the stronger a medicine of this kind is, the more efficacious it must be. In all cases of weakness, we must consider the lightest bitters as the most proper; at first, a drachm of the bitter tincture to an ounce and a half of peppermint water; or an ounce of the bitter infusion instead of the tincture. But at the same time we must recollect, that the stomach is still a weakened organ: the powers of digestion must be still weak, consequently digestion will not be so quick, nor will the food be pushed forward from the stomach so soon as it is in health; and the second meal will be ill digested, because the whole of the first has not left the stomach: for these reasons, a gentle purgative must be joined with the food. A good medicine is bitter pills, formed with such materials as will allow the stomach to act on them without much difficulty.

Of all medicines, bark is the worst here; it requires a good stomach to digest it; it increases every difficulty of breathing that may have existed previous to its use. Now and then a gentle emetic will be useful: we may for that purpose give five grains of ipecacuanha every half hour till it operates. After the bitters have impaired the tone of the stomach, this gentle action will restore its strength, and render them as efficacious as before: when the stomach is strong enough, we may begin with steel, the best form of which is called Griffith's draughts, but it is the most nauseous mixture that ever was made, as originally prescribed; and we should therefore prefer some one of the numerous modes in which this medicine has of late years been revised. By these means the weak patient will be raised up to that state which is nearest health; while the plethoric patient is lowered down to the same point. These two patients being now brought to that same point which is most favourable to menstruation, it remains to discover the best means of getting back the secretion. Having brought down the plethoric, and raised the low and weak patient, so that both are on a par, we may now begin with the emmenagogue remedies.

All medicines called emmenagogues are stimulating; we must never use strong stimuli where the constitution is yet weak, or we shall only exhaust the system, and where there is a tendency to plethora, we shall produce hæmoptoe: these then must not be begun upon till the constitution is amended. Some employ hellebore, which has sometimes certainly evinced great power, for which reason we may give forty drops of the tincture, though, most commonly, the menses will return without giving any thing. Madder is recommended from its supposed deobstruent quality. Instances of its wonderful powers are related in Dr. Home's practice. Now and then electricity has been useful, when the patient all but menstruates. Friction of the lower extremities is good as exercise. Issues have been recommended; dancing, air, exercise, are the real, the natural, and only effectual remedies It is merely necessary to determine to the part; we well know that a mother, directly as she takes the child in her arms, feels the draught of the milk come into her breast, even before the child is put to it.

Profuse Menstruation. We now proceed to consider the opposite state to obstructed menstruation, which is profuse menstruation, or *menorrhagia;* this is where it returns too often, though there may not be too much lost in each time; or, it may be, there is twice the quantity lost at the regular time: in short, in whatever manner the secretion is increased, so as to weaken the constitution, it is called menorrhagia. Whether there be too much or too little tone in the vessels, they may be inactive, allowing their contents to escape as they do in petechial fever, both into the cellular membrane and into the urine.

Profuse menstruation may depend on increased action of the heart and arteries; or on too much food, drink, or stimuli, in any shape. And the symptoms which appear in the constitution from such causes will be just those of plethora; stuffing of the chest, heat and thirst, concurring with this profuse menstruation; and the same treatment of the constitution will remove it: this is the simplest sort of menorrhagia, and requires least discussion. We must prohibit the use of animal food, and keep the bowels in a state of purging with Epsom salts. What we want is not a violent purging, but a gentle increased action of the bowels; by this we pall the appetite, which is another object gained; and it does not allow the food to remain so long in the stomach, while part of the circulating fluids is evacuated by the increased secretion we have produced into the intestines. If this treatment be not sufficient, it will be necessary to apply those local remedies prescribed in floodings.

The next state of increased menstruation is, from relaxation of the system. This will sometimes arise from increased action, which we have said will occasionally degenerate into a weakened state; for the effect of great action is the production of great weakness. Where there is a weak pulse, flabbiness of the muscles, and all the symptoms of weakness and relaxation of vessels, a very small force of action in the heart will be equal to the forcing of blood through an open vessel. All the strengthening medicines as well as astringents will be necessary here; alum and bitters: and where there is nothing of a vibrating feel in the pulse, steel may be given. But, sometimes, when the profuse discharge depends on relaxation of vessels, steel will increase the discharge; yet, where there is no fever, it is one of the best remedies. Next come the cold bath, and moderate exercise in a pure air. In regard to steel, it must be given very gradually at first, as in the mineral waters which are so famous. The stomach will frequently not bear it less diluted. It is very beneficial to recommend patients to some mineral spring in the country, even from a secondary desire to get them out of town, where they may rise early, and enjoy the benefit of a country air. The patient goes with hope and expectation of relief; her mind is amused, and her health repaired by drinking the water, though in the water there should be no virtue at all.

The next sort of menorrhagia does not depend on general, but local weakness, arising from the woman having borne a great number of children, and the weakened state of the uterus. This effect is sometimes dependent on excessive venery; hence we account for the violent attacks of menorrhagia prostitutes are very subject to. It may arise from blows on the abdomen. This is a more unmanageable case than the others; because the weakness is local, and any strengthening remedies applied constitutionally increase the strength of both parts at the same time; so that there still is the same difference between the system and the uterus in point of tone, because they are both equally raised; injecting cold and astringent solutions into the vagina is the best remedy. Though now and then a case occurs, in which the opposite means succeed, where every cold application has failed, and throwing up tepid water has put a stop to it.

The worst state of relaxed uterine system is, a great local weakness of the uterine vessels, which cannot be acted upon through the medium of the constitution. Since the hemorrhage will be increased by whatever increases the strength of action in the heart and arteries, it would be more an object to lower the constitution; and the best measure is, to leave it altogether, only attempting to stop the hemorrhage by local means. But the cold application, so often recommended, will fail; a piece of ice has been in the vagina a whole day without stopping it. In these cases, the most likely thing to succeed is, to introduce an injection into the uterus itself; to do which a tube must be carefully passed up into the uterus, like a male catheter. We must withdraw the wire from the tube, and insert the nose of a small syringe into the tube, and press forward a little of some astringent injection; as soon as it produces pain in the back, the pipe must be taken away, because a very little of the solution will be enough; if there be thirty drops in the uterus, it is quite sufficient. In the very worst case that has been known to happen, this method was completely effectual in the cure. The acetate of lead has been employed in the suppression of uterine hemorrhage with great success. It may be given in doses of two or three grains, every four or six hours.

Painful Menstruation. Dysmenorrhœa, or painful menstruation, is a complaint in a state of nature unknown; but it happens among those who do not marry at the time of life nature intended; for which there are many reasons in the present day, and among the rest the difficulty of maintaining a large family; consequently women are thrown out of a state of nature, not doing that which nature intended. The patient, when first attacked with this disease, feels hardly any pain, or if she feel pain, it is only very slight in the lower part of the back, which is from the consent of certain nerves with the uterus; but in four or five years it becomes established pain in the back, as violent as grinding pains in labour. Such a woman will afterwards bear labour very well, and declare that she would rather bear a child, than experience the pain of difficult menstruation once a month. In this manner the pain increases, but the menstruation goes on very imperfectly for some time and when at length it becomes more plentiful in quantity, the pain lessens, and the last two days of the secretion is not attended with any pain.

The appearance of the fluid in this disease, is not that of menstruation, as it usually occurs. There are coagula of various sizes, and if what is discharged be examined carefully, flakes of coagulable lymph will be perceived. This state arises from interruption of the functions of the uterus, and it is a situation in which the uterus is much less liable to become impregnated; but if it do, the patient may go on to menstruate without any pain to the end of her life, or perhaps with less than she suffered before. This complaint is more frequent in large towns than in the country.

The first object in regard to treatment is to remove the inflammation, for there can be no difficulty in supposing inflammation present at the time the pain is so violent; one strong proof of which is, the coagulable lymph being thrown out. The patient for this purpose should leave off animal food entirely, if possible, at least partially, should avoid all liquors, live as simply as she can, and keep the bowels in such a state, that the stools may not be hard. If she be strong and plethoric, we may bleed once; but it is a bad principle to bleed young people, as it lays the foundation for a larger quantity of blood being formed than ought to be. Between one period and another, the parts about the pelvis should occasionally be immersed in the tepid bath, and afterwards rubbed, and as soon as the pain comes on should be put in a warm bath: this may even be done the night before. The pulvis Doveri should also be given to assist perspiration, which is always an object in the present case. Pursuing this plan, the habit will be broken, and the patient may go for years without menstruating with pain; but when it returns, the same ground must be gone over again. It is often entirely relieved by marriage; so that it may sometimes be useful to recommend this change of state to the consideration of the parents.

Fluor albus—Whites. This is another and very common complaint. Most women conclude it leads to disease, and some are much alarmed at its appearance. In procidentia uteri, it arises mechanically; for its cure, which is sometimes very tedious, the cold water bath is the best remedy of any that we know of: cold water may be injected into the vagina, and if this be not sufficient, an astringent may be added. The case is most unmanageable, when arising at the cessation of the menses: here it often precedes disease of the uterus, and should be treated as if we were in expectation of scirrhus; recommending a careful abstinence from wine and spirits; animal food to be quite cut off, if the constitution will bear it; together with which, no exercise of any consequence should be allowed. An occasional purge should also be given; the injection and bath being used regularly.

Procidentia uteri, or the falling down of the uterus. The uterus is connected laterally to the pelvis by the broad ligaments; and interiorly by the round ligaments. When these parts have lost their tone, they allow the uterus to fall through the vagina, so that the menstrual discharge has been frequently seen coming from the lowest part of the tumour, the os uteri. The most frequent causes are, rising too soon after delivery, or after abortion Next to fluor albus, it is the most common female complaint that is met with. There is a dragging feel in the back, and uneasiness about the hips, arising from the dragging at the broad ligaments: there is also a pain in the groin, and the tedium these sensations produce are exceedingly uncomfortable, though not amounting to pain. The procident uterus will at last interfere with the stools and urine, and be pushed down at those times, when the woman tells us she feels something like an egg; this gradually increases, till at last it falls altogether out of the body, producing pain, and perhaps ulceration of the os uteri, from the contact of the clothes; and the bladder, from its connection with the uterus, being dragged down, makes an angle with itself, which stops the passage through the urethra. Now while there are these powers acting in bringing it down, there are no muscles to bring it back; and where gravitation leaves it, there disease finds it. The only sure relief for procidentia uteri is from the use of pessaries; the best are of an oval form flattened on both sides; the outer edge must be left broad and rounded off, as it is in close contact with the soft parts round it; but towards the hole in the middle it may be made thinner, and this will diminish the bulk and weight: these are to be kept of different sizes. The best are of wood; the cork pessaries cannot be kept clean. They were formerly made round; but this is more inconvenient, and obstructs the passage of the urine and fæces; they also used to be made with very large holes, this was dangerous; the os uteri has become strangulated by getting into it; when this has happened, a pair of pliars may be so introduced, as to break down the ring, so as to enable us to get it out. In introducing this instrument, it is annointed as we please, and so passed edgewise; it is to be laid across the pelvis in such a manner that the largest diameter is from one ischium to that on the opposite side. This disease is curable in early life by a horizontal posture, and the use of astringent solutions.

Dropsy of the Ovarium is by no means an uncommon disease; its first symptom is a sense of pressure on the bladder or rectum; it may further affect the nerves and absorbents, producing dependent symptoms. But it is so long before it produces any real illness, that the water has sometimes been drawn off for some months before any other complaints have been felt. From one tumour, forty-nine pints have been drawn off; and in a few days afterwards, from another tumour in the same patient, nine pints more. There is a case mentioned by Bonetus, where one hundred and twelve pints were drawn off. The fluid in these cases is not serous, but gelatinous and glary; and there has been fat and hair found in these tumours, and even teeth; this will happen where there has been no impregnation. It is a disease which may be borne a long time: in one patient, who had it from the year 1770 till 1798, it was tapped as often as eighty-four times. In the memoirs of the Royal Academy, a woman is mentioned, who had it from the age of thirty to that of eighty. It always begins on one side, and gradually spreads over the other. As to treatment, none in the way of medicine has been known to have the least effect upon it. Tapping will not always be quite successful; therefore, the patient should be warned of the probability of there being more cysts than one.

Another complaint, to which females are subject, has been called *Dropsy of the*

Uterus; but, for many reasons, no such disease can exist, and the expression therefore is incorrect. The cases mentioned of this disease have most probably been hydatids in the uterus. It is, however, a slight complaint, which cures itself. Dr. Clarke mentions a case, where a lady with a tumour of this kind went into a pastry-cook's shop, and sat down in the parlour; the wet which she felt increased, till the whole shop was deluged, and very unpleasant conjectures were the consequence. In another case, a lady was riding in a coach, and driving over the bad pavement, in consequence of which the weak membrane gave way, and the whole fluid escaped. Instead of a single hyatid, there may be some thousands hanging in clusters of all sizes. There will be no symptoms but increase of size, with occasional discharges of water; and, when the uterus does contract, nothing will come away but the water and hydatids.

There are several other diseases which appertain to these organs, but which belong rather to the department of surgery than of the obstetric branch, and to that department we shall transfer them. These are enlarged nymphæ, imperforate hymen, diseased labiæ, polypous tumours, scirrhous and cancerous uterus.

Final Cessation of the Menses. This is a work of time; a work which proceeds slowly, for nature never acts abruptly. The discharge is first broken after having continued from fifteen to fifty years of age. It is necessary, indeed, that it should be stopped gradually, to prevent the constitution from being destroyed; and it happens that the body is frequently broken by this event; in fact it is one of the most dangerous periods of a woman's life. It not uncommonly happens that the menses at this time become profuse, producing dropsy, and the woman is carried off in this manner. Another evil is, that at this period all glandular complaints, which may have lain dormant for many years, now come forward. A little lump in the breast, which has hardly been felt for years, will now be converted into a formidable cancer, which will destroy, if not removed. Not unfrequently a tumour, which has long lain harmlessly on the os uteri, will now begin to give pain, enlarge, and be troublesome. The utmost care is necessary in regard to simplicity of diet, and regularity of exercise and rest; and the state of the bowels should be carefully watched.

At this period, also, there is a disposition to a general enlargement of several of the sexual organs, which often induce a woman to suppose that, instead of finally ceasing to menstruate, she has once more begun to conceive. The uterus appears to swell, the breasts to become full, and there is a sense of motion in the uterus as though a fœtus was in the act of struggling. This affection, for want of a better name, is generally called spurious pregnancy. Perhaps we are not exactly acquainted with the cause, but we know what is of far more consequence, and that is, that, in point of fact, there is no pregnancy whatever, and that the symptoms which thus mimic it subside in a few weeks, when attacked by a course of gentle cathartics, and free exercise.

CONCEPTION.

It is usual, in this part of a treatise on midwifery, to examine the different theories which have been offered to the world on the mysterious subject of conception. The general physiologist, however, has usually contended, that such an inquiry is a branch of his department, and upon the whole we believe the physiologist to be right. On this account we shall transfer whatever is usually offered upon conception, to the article Physiology, under which the reader will find an account of the whole at present known upon this subject.

We have also given a distinct section under the article Fœtus; to which, therefore, we refer for a minute account of the fœtus itself, and the contents of the gravid uterus in general, in regard to their structure and anatomy.

PREGNANCY.

Pregnancy produces a great number of changes in the constitution, dependent upon the change which takes place in the uterus, the great centre of sympathy in the female frame. It also produces a variety of complaints which are rather troublesome than severe, and many of which must rather be palliated, than can hope to be cured, till the abdomen is relieved of its weight. These are, sickness, vomiting, heart-burn, costiveness, or diarrhœa, suppression of urine, and its consequences, and especially retroverted uterus, from a full bladder pressing upon it before it is much enlarged, varicose veins. Pregnancy is also not unfrequently succeeded by abortion or miscarriage. As we proceed we shall have occasion to refer to a few of these; the rest must be relieved by palliations and remedies employed as occasion may demand.

Among the earliest proofs of pregnancy, or of conception, as it is first called, we may mention a disposition to hysteric fits, and, especially in delicate habits, a continual tendency to fever; the pulse increased; the palms flushed; and even sometimes a small degree of emaciation; an alteration in the constituent principles of the blood also generally arises, giving a buffy appearance to the blood; and if from any complaint fever ensue, this buff will be greater in quantity than at any other time it would have been; the face will grow thinner, the fat being gradually absorbed. There are also other symptoms of hectic: but the changes in the countenance are most observable. The little fever sometimes occasions a great churlishness of temper; a woman in such circumstances can hardly bear speaking to, and it frequently creates a degree of fretfulness unknown before.

Another sign of pregnancy is pain and tumefaction in the breast, which is only a part of the uterine system, and is affected from the same cause with the uterus. The areola becomes darker and broader than before; the rete mucosum is sometimes so altered, that it is as dark as that of a mulatto, while the skin generally is as fair as alabaster. The breasts enlarge, and will not bear the pressure of clothes so well as before; the woman will not be able to lie on one side so well as before: this proceeds from the skin not increasing in proportion to the secretion of the glands.

The next part that sympathizes with the uterus is the stomach; this is generally perceived in the morning; for though occasionally it is affected the whole day, it is generally felt on first being erect in the morning. The morning sickness in the progress of pregnancy is closely connected with the growth of the child; so much so, that it has sometimes been a rule to judge that where this ceases the child is dead. Pregnant women have antipathies and longings; and this desire is in some for the most strange things, it is well known to almost every medical practitioner. No woman can be with child if she menstruate; this is the *sine qua non* of pregnancy; for though there may be sometimes an appearance of blood, there is not that regular appearance of uncoagulating fluid which constitutes the menses; even in Hippocrates we may see this. If in a young woman, between the age of fifteen and thirty-two, the breasts shoot and are very painful, and she be not regular; if the areolæ be enlarged and dark, and she have morning sickness, there is little doubt but that she is with child. It is not likely that all these things should by any accidental cause be present at the same time, though any of them may arise. There are also peculiar symptoms attending the pregnancy of particular women, as a cough, tooth-ach, head-ach. Dr. Clarke relates an instance of a person being as completely salivated during a certain period of her pregnancy, as ever was a patient in the Lock Hospital. When these symptoms occur they mark a peculiar idiosyncrasy in the constitution, and are the surest possible indications.

The uterus being the great centre of sympathy, the diseases of pregnancy are so many sympathies: and, considered as such, there are no parts which may not become affected by its influence. Not uncommonly there is a continual state of low fever; and yet pregnancy prevents the coming on of many diseases; but though it prevents many, it produces some which are serious.

The most troublesome complaint to which a pregnant woman can be subject, is a retroverted uterus. When this disease was first known, it was supposed to arise from fright, or some other surprise; but this is not true. There are no muscles attached to the uterus, nor is it capable of being influenced by muscular action. The only true cause for this change of position in it is quite mechanical. There is frequently great fulness of the bladder, and if it be very much distended, the retroversion will happen in consequence. The only period in which it can happen, however, lasts but four weeks, between the end of the third month, and the end of the fourth. For in the early months of pregnancy, the uterus, in length from the fundus to the cervix, is not so great as to fill the space between the sacrum and the neck of the bladder, and cannot for that reason produce suppression, which alone constitutes the disease. This applies to all situations of the uterus in unimpregnated women, and women who are with child till the close of the fourth month of pregnancy; after which the uterus cannot be made to go down into the pelvis. When the uterus has once fairly mounted into the abdomen, it is impossible for it to pass down into the pelvis again.

The retroversio uteri occurs thus: the bladder becomes full and rises into the cavity of the abdomen; the neck of the bladder in rising draws up the os uteri with it, which drawing up of the os uteri is assisted by the fundus of the bladder pressing down that of the uterus, and, in nineteen cases out of twenty, the bladder in this way becomes the occasional cause of complaint; and when the complaint is formed, the suppression of urine is the only material object to be attended to. For, the uterus being retroverted, the woman cannot make water; therefore it must be drawn off by the catheter.

When the water has been once drawn off, it will be necessary to pass the catheter twice a day, till by the enlarging of the uterus, it rights itself. As it increases in size it will gradually rise, but as it may not be convenient for a medical practitioner to call twice a day for some weeks, it is sometimes advisable to attempt the reducing it; which is done by the patient placing herself on her hands and knees, when the two fingers of one hand should be passed into the vagina, and a finger of the other into the rectum, by which means it is sometimes possible to succeed. Where the event is left to time, the uterus is sure to recover its proper situation; for which reason it is preferable to leave it.

In attempting to reduce a retroversio uteri, we must recollect always to empty the bladder, and never use force.

Abortion—Miscarriage. At any time after impregnation, abortion may take place: it is one of the most common complaints of pregnancy, whence it is matter of no small consequence that every practitioner should well understand it.

Abortion is not peculiar to the human species, but they are more subject to it than other animals, because they lead more unnatural lives. We see, agreeably to this rule, that the domestic animals more frequently abort than those that are wild. In the human species the greatest number of miscarriages are between the eighth and twelfth week; perhaps there are more at the tenth week than at any other time of pregnancy; but why this should happen at that time more frequently than any other, we are ignorant.

There are two kinds of constitutions very liable to miscarriage; the most strong and the most weak. The most strong, because there are some causes which act upon the vascular system: the most weak, because many causes act through an irritability of the nervous system. There are also various occasional causes of abortion, and among these we may mention sympathy. This has such an effect with other animals, that there is not a shepherd but knows that if one sheep abort, others will almost always abort too. If a sheep lamb, the shepherd always separates that animal from the flock, to prevent the other ewes lambing before their time. One animal is thrown into action, because the other animal is acting. Consents, also, are common in animals, as well as sympathies. Certain parts of the body are connected in disease; the nose with the rectum in ascarides, and the shoulder with the liver; crying is known to produce tears in many beholders. These are so many instances of a fact, which proves the impropriety of a pregnant woman being ever in the room with one who has been lately miscarrying. Yet perhaps the true cause of abortion is an indisposition in the uterus to grow after it has reached a certain size; when arrived at that size contractions begin, labour pains succeed, and this being accompanied with the expulsion of the ovum, constitutes miscarriage; whether this happen at the second, third, fourth, or fifth month, it is still abortion.

The uterus is in some degree of the same nature with the bladder. In different people we know the bladder, without inconvenience, contains a different quantity of urine; in one person it will not, without his feeling uncomfortable, contain more than six ounces; but that is not as much as it can hold, because it will, if necessity urges, contain four times that quantity. In proof that it can dilate, every person may have observed, that at one time the quantity which he retains with convenience will vary from that which he retains at another time. It is the same with the uterus, which may be disposed to hold a certain quantity of contents only, by which the ovum attains not more than a certain size before it excites the involuntary action of the uterus, by which the whole is expelled. That the disposition exists, and that this often produces miscarriage, appears hence, that many women go to the usual time of miscarriage, and feel all the signs of disposition to abort, and yet, if they keep quiet for a sufficient length of time, they will recover, and go the full time of pregnancy. This is accounted for by the disposition in the uterus to contract at a certain period of gestation. Tumours also may cause a disposition to miscarriage;

Constipation acts in the same way, for, while it lasts, it produces exactly the same effect that other tumours would. All circumstances, which, by increasing the circulation, keep up too great a velocity in the motion of the blood. Thus, violent exercise will produce miscarriage; it will, by the increased motions of the blood, separate a portion of the placenta from the uterus, which is very easy to conceive; for a certain force, being applied to the cells of the maternal part of the placenta, will be sufficient to rupture them; and the cells giving way, the blood will make its escape between the surface of the placenta and membranes, so as to form hæmorrhage. Where the flow of blood from the ruptured part is considerable, and it finds a different course between the membranes leading to the os uteri, it will produce then a considerable degree of hæmorrhage. Violent hæmorrhage will also sometimes arise from the use of spirits in too large proportion. Now and then accidental injuries done to other parts of the body will cause a partial separation of the placenta from the uterus. Acute diseases of the mother, pleurisy, acute rheumatism, continued fever, small-pox, scarlatina, may any of them produce miscarriage: there is no disease in which abortion is so dangerous as in the small-pox. Passions of the mind will frequently cause it; and none so surely as those which increase the action of the heart and arteries. Rage may separate the placenta from the uterus very soon. It is not essentially necessary that the force of action of the heart and arteries in general should be increased, because increased local action of the part is quite sufficient; whence the union of the sexes often causes women to abort; and, to make sure of breaking the habit, the best way is to separate the wife from her husband for a time. Violent exercise of almost any of the passions may produce the same effect.

With regard to the signs of approaching abortion, the first and most obvious change is the absence of the morning sickness, which sickness is always a sign of health in the fœtus, and goes away when the fœtus dies. Another symptom preceding a miscarriage is, a subsidence of the swelling of the breasts, from being hard they become flaccid; by these signs will any woman, but particularly if she have miscarried before, know the approach of this state. There are also pains about the abdomen and back, which are so many evidences that the uterus has taken on this action. Hæmorrhage, in general, also attends these symptoms, though sometimes a miscarriage may happen with very little loss of blood. Women miscarry in various ways, with regard to the progress of the abortion. In some the ovum is expelled, and in others it will come away in pieces. The ovum and its membranes may be thrown off first, while the decidua does not appear till afterwards; sometimes the ovum will come away in a clot of blood, and it would not be known as an ovum, if the clot were not broken down and examined: at times the membranes will break very early, and the fœtus will come first. In some abortions there is great pain; the grinding pains will sometimes equal those of labour; while in others there is very little, the ovum appearing to drop off from its connection with the uterus, upon the os uteri being relaxed, just as premature fruit drops from a tree; sometimes the loss of blood is great, at others little.

As to the prognosis in miscarriage, it will be influenced by the state of the constitution: if it depend upon the contraction of the uterus alone, the pains will go on as in labour, till the whole ovum is expelled. But where the miscarriage depends on some cause acting on the circulation, the woman will often lose a large quantity of blood, become cold, faint, and the blood will stop. If during her fainting she be revived by wine and warmth, the hæmorrhage will return, and the abortion perhaps be confirmed; but if these stimuli be avoided the blood will often coagulate, close the breach of continuity in the placenta, and the woman will go her full time of pregnancy.

There is very little danger in abortion, generally speaking, when happening in the five first months. We may say, that, provided the constitution be good, there is no danger before the fourth month. The vessels at this time are small, and the hæmorrhage is seldom rapid, and the safety or danger of the patient will depend upon the proportional size of the vessels from which the blood issues, together with the time in which it is lost. But if it be continual, though not from large vessels, it may at length kill, either immediately, or by overpowering the constitution. A child may be bled to death by leeches, and an infant has been known to die under the operation of a single leech; a woman who does not die while the blood is flowing, may die in consequence of dropsy caused by the loss of blood. Abortion never ends at once in death, but it produces weakness and dropsy. All miscarriages are more dangerous while the woman has an acute disease, and most so with the small-pox; the most dangerous days being from the eleventh to the thirteenth day of the eruption. When hæmorrhage happens before abortions, it does not follow that the ovum must be destroyed; enough of the placenta may still remain attached to the uterus to carry on all the purposes of life, and the pregnancy will go on. The constitution, if good, will generally bear the loss of a little blood; as much should be taken as the patient can bear, for twelve ounces at once will be more effectual than sixteen ounces at twice in restoring the balance in the system. After which a saline draught may be given every six hours, with about six drops of laudanum in each; it is rarely useful or necessary to press the opiates beyond that quantity; a large dose of opium will frequently increase the force of action in the heart and arteries, while a small one will keep it in the state desired. The bowels must be kept lax with small doses of the purgative neutral salts; the patient must at the same time be kept quiet, with little or no animal food; farinaceous decoctions, with vegetable nutriment are all that should be taken while this state remains, as these do not add to the force of the circulation.

If the abortion, instead of arising from these causes, and being attended with these symptoms, proceed from passions of the mind, or a relaxed state of the os uteri, the plan to be adopted is the use of opium, and the quantity must be considerable: if it be small it will do nothing; but if large, the pains in the back and uterus will be relieved, and the abortion quite put by. When a habit of miscarrying is acquired, the woman will know the period at which it is likely to occur, and, before that time come on, laudanum should be had recourse to, from ten to fifteen drops, increasing it gradually till the time of danger is passed over.

The next occurrence demanding attention is the hæmorrhage: we see clearly that fainting is nature's method of restraining a flow of blood. In faintness we know the small vessels are constricted by the whiteness of the skin; we also know that cold is remarkably effectual in stopping a flow of blood from any part, but especially the uterus: not only cold air, but cold water, and even ice, to the back, belly, and parts themselves; every thing should be taken cold, and congealed if possible; ice creams, juices of fruit, seeds, &c.: all the body should be cold, both externally and internally. Considerable benefit is derived from ice being introduced into the vagina, and replaced every two or three hours; this will restrain uterine hæmorrhage more frequently than any thing else; and if it do not stop it, the constitution will still be secured from the effects which a more profuse hæmorrhage would have incurred, and the patient be preserved from the excessive weakness which would have been the consequence of it. Where there is pain without hæmorrhage, there is no necessity for being very anxious; for in that sort of abortion the pains will gradually increase as in labour, and the ovum will be thrown off; after which the pains will gradually go off again, and abortion must take place here before the pains can subside. But it sometimes happens that there is great pain with the loss of blood. and though it may be that nothing good can be done to restrain the hæmorrhage directly, yet assistance may be given in emptying the uterus; for after the ovum has separated, sometimes it will not come away; in this case the finger of either hand may be introduced and some part got away; and if this should not be practicable, it is sometimes possible to get in two fingers, and by this contrivance pass them through the os uteri, and restrain the hæmorrhage by compression.

Should the ovum not be capable of being brought away whole, the membranes should never be broken, unless when, after the fifth month, the child can be felt through them before tearing them, in which case it will be possible to get hold of part of the fœtus, and so get it through and relieve the woman from danger; for though in the early months abortion is not dangerous, the danger increases every day, and when it admits of being treated like premature labour, it always should be, as that treatment ensures absolute safety to the woman; but if the membranes be ruptured in any early abortion, or before twelve weeks, the odds are, that there will be no more pains, for the waters having escaped which formed the bulk of the ovum, nothing but the thin skin remains behind, and these are so small, that they will not stimulate the uterus to act, and yet the vessels will continue to bleed.

Abortion is prevented, in the first place, if by observation and knowledge of the patient's life, and knowing her to have been subject to miscarriages, we may induce her to avoid the same cause which has before produced it. It will next be necessary to take care that this does not occur, even if the former cause is applied, by bleeding and opening the bowels, where there is sudden occasion, otherwise by laxatives and occasional bleeding only. If, on the contrary, there is reason to believe that the woman miscarried from weakness, we may prevent a recurrence of it by strengthening her by good diet, and the use of bitters and tonics. There are women who appear to miscarry regularly from the state of the uterus being, as we have already observed, unfavourable to growth beyond a certain extent: in this state abortion is frequently prevented by immersion in the warm bath; it lessens the disposition of the uterus to contract. If there be any reason to suspect great weakness in the uterus and uterine vessels, the application of cold will be of great advantage in giving the proper tone to the vessels. Many women miscarry in consequence of the connection between the sexes: when this cause exists, the parties should be separated till the period is gone by; for after quickening there is infinitely less risk of its occurrence.

LABOUR.

The gestation being completed, labour, or the pains so denominated, is the natural process by which the child is forced into the world.

There is some little variance in the term of gestation of different women; at least the regularity in the human species does not equal that which we behold in other animals. The usual term is forty weeks, or nine calendar months; and the period from which the time ought to be dated, is a middle point between the antecedent and succeeding times of menstruation. The Roman law allows ten months to legitimate parturition, or, in other words, ten months after the death of the husband. Hippocrates, upon whose opinion this law was probably founded, allowed this term, in like manner, as its utmost stretch, and would not extend it a moment beyond. The Old French law (for the present may perhaps vary) was coextensive. Yet Haller gives instances, which it is difficult not to credit, of eleven, twelve, and even more than twelve months; whence the law of England is wisely silent upon the subject, and chooses rather to trust to the fair professional opinion and observation of the day, in connection with collateral circumstances, than rashly and abruptly to ruin a female reputation upon a moot and controverted point.

It is a law of nature, that about this period of time the fœtus should be expelled from the womb, and hence, whether living or dead, whether light or bulky, whether the uterus be strong or feeble, the fœtus is expelled. A thousand causes have been assigned for expulsion at this rather than at any other period, but not one of them appears to hold. It is a law of nature, and we know nothing beyond.

Labour then is intended to expel the child and its membranes from the uterus; and from the variety of phenomena it presents, it has usually, and may conveniently be divided into three classes: *natural*, *difficult*, and *preternatural*.

In the first kind the head presents, and the pains progressively increase, and in consequence of such increase, by pressing the head against the orifice of the uterus, gradually enlarge it, by which it becomes protruded into the vagina: the same coercive power being exercised over which, the head of the child is shortly afterwards protruded into the world. The whole process is completed within twenty-four hours at the utmost, and is unaccompanied with difficulty or danger.

In the class of *difficult labours*, the head indeed still presents; but the term is protracted beyond this period from accidental circumstances, that render it doubtful whether the life of both the mother and child can be preserved: or are else accompanied with other accidents, as twin cases, floodings, convulsions, rupture of the uterus.

The class of *preternatural labours* includes every presentation besides that of the head, or that of the head itself in conjunction with an upper or lower extremity.

NATURAL LABOUR.

In this division of labour there are four stages, according to the mode in which its progress is usually contemplated. The first stage is that in which the head of the child enters the pelvis, passing down as far as it can move without changing its position. The second includes the period of the child's head passing through the cavity of the vagina and os externum. The third, the change taken place in the vagina and os externum. The fourth, the delivery of the body of the child, and the expulsion of the placenta. In one of the two first stages the os uteri dilates, and in one of the three first the membranes are ruptured.

In the regular process of natural labour, the head, by the contractions of the uterus, is forced down and passed through the os externum. The uterus, after an interval of rest, again contracts, by which effort the shoulders are expelled. The breech and lower extremities presently follow. During the progress of expulsion the uterus contracts around the remaining parts of the child, and at the time the placenta only remains, the uterus is only sufficiently large to contain it. The next effort of the uterus, therefore, by contracting its internal surface, not only assists in pressing out the placenta, but becomes the cause of the separation; while the same power, which separates the placenta and throws it off, prevents the occurrence of any serious hæmorrhage. This is a most beautiful illustration of the mercy and power, as well as wisdom of the Almighty.

At the commencement of this process there is almost always a discharge of mucus, tinged with blood, from the vagina, and the blood is sometimes intermixed in considerable quantity, a fact, however, which is of no consequence. There is at this time also, very generally, an uneasy oppression about the præcordia; and as the pains increase in violence, vomiting will often arise from the extreme distention of the os uteri, while the pulse generally augments in strength and frequency. At the same time the progressive pressure of the child's head expels almost involuntarily both the urine and fæces; while, from the vicinity of the sciatic nerve, cramp and paralysis occasionally take place from the same cause.

In labours of every kind there are many things to be attended to, which, though seemingly frivolous, are yet of great importance, and, in general, are only manageable by practice: first, then, the bed should be so made that the woman may lay comfortable both in labour and after labour, and that she may lay in the best way with regard to our convenience. If she be used to a mattress she may lie on one, it being the best sort of bed; but if she be afraid of a mattress, she may be allowed to lay on a feather bed, first making it as nearly as possible a mattress by beating the feathers all away to the other side of the bed. Upon the feather bed a blanket should be laid and a sheet, and upon these a common red sheep skin, or instead of it a piece of oil-skin or oilcloth; over this a blanket doubled to four thicknesses; and lastly, a sheet upon this four times doubled, only lengthwise: this last sheet is to be laid across and secured to the bedstead by tapes. When the os uteri is so far dilated, that in the event of the membranes breaking it would receive the apex of the head, the patient should be put to bed, but not before; for, with some women who have had children, it is astonishing how fast the os uteri will dilate itself; it sometimes takes place with such prodigious rapidity, that there is only time to get the woman on the bed before the child is born.

The woman should be undressed before getting into bed; her shift had better be tucked up around her; and, instead of a shift below, a petticoat will do much better, as it saves the linen. When placed on the bed she must lay as near as possible to the edge, and in the posture before described. This is equally proper in the easiest and most difficult labours. The lying-in room should be as airy as possible; and upon this principle it is that the poor people in the country get about sooner after lying-in, than the same class of inhabitants of this metropolis: in the generality of cottages it is not necessary to be very anxious about this, there are few of them so air tight but that they will do without a ventilator. If food be proposed during labour, we should generally speak rather against than in favour of it; for if food be taken, it must be either digested or undigested; in either case it is productive of mischief: if digested it becomes the fuel of fever; if it remain undigested, the stomach and bowels are all the worse for it; the proper refreshment is tea with dry toast, as this will do no harm.

The urine should frequently be evacuated, and the perinæum supported with the practitioner's left hand as soon as the child's head rests upon it.

The reason why the perinæum needs this support is simply this; a woman bears down with a force equal to three, one of which is voluntary; the natural structure of the perinæum has enabled it to support, without danger, the contraction of the uterus; it has therefore, of itself, a power superior to two, which is the force of uterine contraction; but in consequence of the patient's voluntary efforts being added to the involuntary efforts of the uterus, a force equal to three is acting against a power equal to only two. By pressing against this part, we do not say the head shall not come out; we only say it shall not come through a hole which is too small to receive it. In supporting the perinæum, it may be done through the medium of a folded cloth, which is held in the hand upon the perinæum, and keeps the hand clean from occasional discharges of meconium or fæces, waters, &c. and the perinæum should not be left unsupported till the shoulders are born; indeed laceration more frequently happens while the shoulders are passing, than when the head is. The great art is, to give support close to the edge, against which the greatest force is acting, for the parts give way first at the edge. The perinæum is to be supported from the time that it is stretched by the pressure of the head, and we must take care that we apply sufficient force to counteract the voluntary efforts of the patient.

As soon as the child is born, breathes, and cries, we should tie the navel string. To do this, about ten threads must be joined in the ligature; the first made about two inches from the body, and the second the same distance from that again, or towards the placenta. The division is made between the two ligatures, the second being only intended to prevent the blood escaping from the divided cord, and staining the bed. The next step to the separation of the child is the placing dry clothes under the patient, and to the perinæum. Midwives apply them warm; this should only be done in winter, for warmth increases the discharge from the uterus. We should then lay the hand on the abdomen, to ascertain whether there is another child in the uterus; being satisfied of that, we are to proceed to the extraction of the placenta.

The uterus contracts after the birth of the child, so as to contain only this substance; and its contractions being continued, the surface naturally must first loosen and then separate itself from that of the placenta; and the same contraction which separates, expels it. It is generally necessary to pass the fingers up upon the cord which is held in the other hand, and if we be able to feel the root of the placenta, the separation is complete, and we have only to get it gently out from the os uteri. If the root of the placenta cannot be felt, it is dangerous to pull the cord with any degree of force; it is still attached to the uterus, and may produce inversion of the womb. When, by gently drawing the cord, we have got the placenta and membranes down to the os externum, we should have a basin ready to slip it under the bed clothes; and in drawing the placenta out, the cleanest way to bring the membranes with it is, to turn it round, by which means, after a few turns, we separate them neatly; after which it will be convenient not only to lay under the patient the end of the folded sheet which hung over the bed side, but also to make some degree of pressure upon the abdomen by bandage; after which she may be entrusted to the care of the nurse.

DIFFICULT LABOUR.

Of difficult labour there are three species: First, those labours which, though protracted, are ultimately accomplished by the powers of nature unassisted by art. Secondly, those which, although requiring the assistance of art, yet are compatible with the life both of the mother and the child. Thirdly, those which, besides being accomplished by artificial means, require that either the life of the child must give way to save the parent, or that of the parent to preserve the child.

The first source of difficulty is *weakness*. We know that labour requires a certain quantity of force or power, therefore labour is more likely to be difficult in weak than in strong women. We have many proofs to the contrary; but, generally speaking, it is so.

Fatness is another predisposing cause of difficult labour; fatness offers resistance, and generally occurs in women of weak constitutions: so that here we have both resistance and want of power. All asthmatic and pulmonary complaints generally will cause difficult labour. We know that to resist the contractions of the uterus it is necessary to take and keep a full inspiration; and where the chest is not equal to the task imposed upon it, the labour will be more probably protracted.

Deformity of Body, attended with constitutional weakness, will generally produce difficulty in labour; it is most likely that in these cases the pelvis is not formed as it should be, partaking of the state in which most of the other bones are. If a woman be too young, the pelvis will not be perfectly formed; and if too old, the parts will be rigid. The best time for a woman to commence childbearing is between the ages of eighteen and twenty-five. For though a woman may be in perfect health at thirty-six, yet we know that the parts were designed to be used at eighteen, and have been inactive for the rest of the time, and cannot then be so fit to act.

The next kind of difficulty in regard to labour is *Debility of the Uterus*, not disposing it to contract. This may happen in a woman otherwise strong, as a man may have a weak arm, while the rest of his body may be strong. Such a woman may have no character of weakness about her but this, so that we may not be able very readily to guess at the cause when it exists. It is not proper to give stimulants and opiates here, to provoke contraction of the uterus; when stimuli are given, it is not recollected that they produce fever. Opiates are not quite so exceptionable; they save time to the practitioner, but in their effects we cannot govern them, else they occasionally save the woman's strength.

Another cause of difficult labour is the *irregular contraction* of the fibres of the uterus; where the longitudinal set, and the circular set, do not contract as they should do relatively to each other. This always arises from irritation of the os uteri, in needless examinations. The patient has strong labour pains without the delivery being forwarded. We may here recommend a dose of opium; after which, it is probable that, upon their action recommencing, it will be in the natural manner.

Passions of the Mind are the next set of causes of difficult labour. The effect of them is to diminish the strength and frequency of the pains, till they at last subside altogether; and this will also occur in constitutions where the powers of action were originally very good. These things shew the necessity of keeping up the hopes of the patient to the pitch of security and confidence; for from the moment that her confidence fails her, from that moment the pains are protracted, and that merely from the state of doubt and arising anxiety. This points out the necessity of never forming a prognosis of duration; we may form and declare our opinion as to the event, but never the length of time which the labour shall last; for if we were to speak the truth, our prognosis would be in general very unsatisfactory. If we only tell a patient it will be to-morrow before the child is born, it will depress her resolution, and damp her perseverance; the pains will diminish, and she will be all the worse for what has been said.

The *os uteri* may also become a cause of difficult labour by its being rigid. This state is natural to some women, and especially those who are somewhat advanced in life when they begin to bear; also with the first child the parts dilate more slowly than in subsequent labours. Rigidity may arise from repeated and useless examinations; and where the os uteri is rigid, it forms one of the most painful labours, accompanied with excruciating pains in the back. This state is attended with inclination to vomit and to sleep, both which things are in themselves useful: for sleep restores the strength of the body, while the vomiting strengthens the bearing down.

The os uteri, when in this rigid state, resembles inflammation, it being tender to the touch; its hardness almost reminds us of a board, which is bored through the middle with an augur. This is one of two kinds of rigid os uteri, the other description of which gives a very different feel: it is more apt to give way under the finger, is of a pulpy substance, and in some measure resembles the intestine of an animal filled with water and drawn into a circle; and though this is not so rigid to the finger as the other, yet it is longer in giving way. This sort of swelling, or thickening, is sometimes occasioned by œdema, or ecchymosis, as it has been known to arise in a quarter of an hour; at the same time it lies between the os pubis and the child's head. It generally happens, that from the pain there is a degree of fever present. But when once one part of the enlarged circle retires behind the head, the whole of it slips up, and the child is sometimes born in five minutes, if there be no resistance from the soft parts.

We must here be very cautious not to allow the woman to exhaust herself in fruitless efforts; for which reason we should explain to her that it will be of no avail, that the mouth of the womb is not large enough to admit of the child's passing, and that it must be a work of time, and will be a work of time, notwithstanding all the endeavours she may make to shorten it. We should, in the meanwhile, fill up our time, and keep up her attention, by ordering an injection, or making some other preparation; and if the last be a six or eight ounce mixture, in case the os uteri is very irritable, and by frequent examination has been rendered more so by being deprived of its mucus, twenty drops of laudanum may be added to the mixture. Where the os uteri is rigid and unyielding, the vagina hot and dry, and accompanied with a feverish state of the system, the most effectual remedy is blood-letting.

In difficult labours it will now and then happen that the *vagina* is very rigid, making considerable resistance; this very generally depends on irritation, by the interference of the midwife. The consequence is, that inflammation of the periosteum and membranes covering the bones very often arises. In such cases, patience and horizontal posture are both grand remedies: besides which, why not use fomentations, as in whitlow, or any other case where relaxation is wanted?

The next cause that impedes labour, from resistance of the soft parts, is a full bladder and suppression of urine. This is not a formidable evil In early examination we shall, instead of feeling the mouth of the uterus, come to the neck of the distended bladder; but in the progress of labour the child's head presses upon the neck of the bladder, which pressure causes the suppression. This will never happen if the bladder be frequently emptied in the early part of labour, because the time between the head's being at the upper aperture of the pelvis, and delivery, is in general of a moderate duration, in which no serious accumulation can take place in the bladder, unless the labour is very long. When it is necessary to draw off the urine, the catheter will enter the meatus urinarius with greater ease if its curve be a little increased. With regard to a woman in this situation, we should never rest satisfied that her bladder is not dangerously full, because we see a little water which has passed without the instrument. We must never allow the woman's delicacy or dislike, to prevent our examining: we must represent to her the importance of it; for if she die from a burst bladder, it will be a very deplorable circumstance, as it is so easily prevented.

Contraction of the vagina forms another impediment to labour. If this be the consequence of a cicatrix, it will sometimes be proper to divide it by a knife, in order to allow the child's head to pass through: when we attempt to divide it high up, we are in a very delicate situation on account of the bladder and rectum: and if the head have passed so far forward as to come into view, it will be advisable to leave it to nature. Excrescences arising from the os uteri or vagina may impede labour, though these causes in general only produce slight difficulty: the os uteri has been known to be in such a state from a tumour on its side, that only two-thirds of the circle have dilated for the passage of the child's head. In most cases the tumour is pushed aside, so that it occupies a projected situation during labour, and the head passes very well.

An *unfavourable state of the Ovum* may protract labour. It is said, that the navel-string may be tied round the neck of the child in its passage through, by which the effect of each pain is lost; being held on each side by the string, it is forced a little forward in each pain, retiring again as soon as the pain goes off. It does not appear likely, however, that this ever happens, because the effect attributed to the elasticity of the cord may be seen in every labour, from the elasticity of the soft parts, and more particularly where the head is larger than the cavity of the pelvis. So that there is no reason to believe this to be a cause of difficult labour. Yet we may now speak of its treatment, when it does occur. The cord is frequently turned round the neck of the child, when the circulation is not in the least interrupted; in this case we have only to turn it off the neck, and if the circulation be felt, leave it. Where the loop round the neck is tight, so as to interrupt the pulse, we may loosen it by passing the finger between it and the skin of the neck, so as to feel the pulse again. It has been said to be sometimes so tight as not to admit of its being slackened at all. This is just possible, and the most improbable thing in the world. It is then to be divided between two ligatures.

Rigidity of the Membranes has been stated to produce difficult labour. It has been observed, labour was quicker when the membranes were ruptured early; but though the labour is slower, it is safer where the membranes are unruptured. Where the membranes are to be opened, there have been a great number of pretty looking instruments invented for doing it. Long tubes, at the end of which blades or points were projected. But it requires more skill in telling where they should be let alone, than where they should be meddled with. With the first child they must never be broken: the inferior parts of the passage dilate but slowly, and require the assistance which the membranes are capable of giving. But in subsequent labours, perhaps, it may be admissible, where the pelvis and soft parts are known to be capacious and yielding. The time when they should be broken is when the head may be received into the os uteri upon their breaking. Never must they be broken before the os uteri is of the proper size; if they be, we cause a continual drivelling of the waters, which in itself is productive of great delay. It will often protract the labour two days: it has been known to protract it three weeks.

A frequent cause of *the Rupture of the Membranes* is the using too violent exercise for the parts to bear. The riding in a coach over the rough stones will bring it on, as the weaker part will always give way first. Another cause of the membranes giving way may be the death of the child, for dead members will give way when a living member will not give way.

The next cause of difficult labour is in the *disproportionate size of the Child's Head*, compared with the cavity of the pelvis. This is not mollities ossium; but a disease, which, independent of that, is capable of producing considerable difficulty. The different size of the head will regulate the progress of the labour. The head may be so large as not to pass, and this increased size of the head may be combined with a state of pelvis, which in shape resembles a man's; which pelvis would not admit of a head of an ordinary size. The head may also be accidentally larger than it should be, for two heads of the same absolute size shall in labour prove to be of different sizes: that is, the first shall give way, and allow of compression by the soft parts; while the second, by being more perfectly ossified, will not allow the bones to slip one over the other, as in the first instance; for which reason one of these two heads will, in effect, be larger than the other. The volume of the head may be also increased by a descent of one or both the hands; or it may occupy undue space by a wrong position. In all these cases, instead of trusting to time, or using instruments, we may generally afford relief by introducing the fingers and turning the head aright.

Independently of these difficulties, there are others of a totally different class; and which produce difficulty chiefly by rendering a labour more complex. The first which we shall notice is the presentation of the *umbilical funis*.

We have already explained that the fœtal life is that of a fish; that it is furnished with an apparatus resembling gills; that the funis is analogous to the pulmonary artery and vein; and that the circulation through it, if stopped, produces death, upon the same principle that suffocation does to an animal which breathes. Hence the importance of the funis presenting. Let what part will present, arms, legs, shoulders, or breech, it is of consequence from this circumstance chiefly. It is of no consequence in regard to the woman's safety, and all treatment is applicable merely upon the simple ground of preserving the child's life while labour goes forward. From whatever cause the funis has presented, the effect is the same, and the treatment must be directed by the circumstances of the case. Suppose the membranes lately broken, and the os uteri pretty fully dilated, he funis down. The best practice here will be, to turn the child, and bring down the feet, as this affords the best chance for saving the child's life; though, where this happens with the first child, it is as well to let it remain, for the operation of turning will then of itself produce the death of the child. Suppose the head in the pelvis, and the navel string pulsating in the vagina; the best way is, to return the navel-string, and follow it up with a long strip of cloth, or handkerchief, artfully pushed up, so as effectually to prevent its coming down again; and as this is the only chance that we have of keeping it above the pelvis, it should never be left undone; and at last the head will get so far down, that it can be delivered by the forceps immediately. In all cases we should recollect, that the woman's safety never must be hazarded by doing that which will only obtain a precarious chance for saving the life of the child.

Plurality of Children. The disposition to multiply is general throughout the whole creation; even in vegetables it is not unusual to see two kernels in one nut; and the sheep, instead of having one lamb, will sometimes bring two. All uniparous animals may have two young ones, though in some species it is more frequent than in others; it is not so common for a mare to have two foals, as for the ewe to have two lambs. In the human subject twins occur once in about forty-eight labours; this calculation is taken from the lying-in hospitals of London, Edinburgh, and Dublin. There are sometimes more than two; as three, four, and five; but such instances are extremely rare. Dr. Osburn mentions a case, where in an early miscarriage he saw six distinct ova, each complete; and there is a monument in Holland to a woman, who, the inscription declares, had 365 children. But it signifies not, whether there is one or 365 in the uterus, for each has still its distinct bag of membranes, each its own placenta; though sometimes the placentæ are joined so closely, that they would almost seem one cake.

There is no mark by which we can distinguish twins till after the birth of one child. It has been said that labour is then more slow than at other times; but this would imply that single labours were never slow, which happens to be very far from true. Another opinion is, that the woman is bigger than in other labours; and this would seem to be very natural; but it certainly is not very true, but very much the contrary; and many practitioners have declared, that they have never once been right in their opinion upon this subject. So that the difficulty of the labour will at first depend on itself without any reference to the child. But after one child is born, we can easily lay our hand upon the abdomen, and determine the point; not forgetting that, where there are more than one child, the placenta must never be brought down till the last child be delivered; for if we use any force, so as to detach a part of the placenta from the uterus, we produce a flooding. If the abdomen be examined before delivery, we shall feel the tumour reaching high up to the scrobiculus cordis; if after delivery, we shall perceive a rounded tumour lying on one side above the pelvis like a foot-ball. If we examine the abdomen in a twin case, after one child is delivered, we shall not be able to say, from the diminished size of the tumour, that one child has come away.

When we have ascertained that a second child remains in the uterus, we should wait quietly, and without communicating the fact to the patient herself, lest we alarm her, till by a recurrence of the pains we find the part that presents; and if it be an arm or shoulder, we should tuck up the sleeve of our shirt, and pass up the hand greased into the uterus, without any preparation on the part of the woman; it is here better avoided, and the child may be turned at once. The one child has already passed, therefore the contractions of the uterus and vagina will be a smaller impediment here, than in any other case. Before we thus act, however, it will be better to leave the patient to recruit herself a while. Should there be a remission of labour-pains, and no urgent symptom requiring the interference of art, if the practitioner be a young man, it is best to wait about four hours, before he does any thing towards the delivering the second child; an experienced person probably need not wait so long. If we wait four hours, no harm can happen from hastening the delivery; we have waited so long as to justify ourselves in the eyes of all the world.

A twin case is not quite so safe as a single birth; for the woman will sometimes die without our being able to give the least reason for it. As there have been some fatal instances, we should be upon our guard not to say there is no danger in such a case; we may say they are commonly not cases of danger, but should not, when asked, affirm that they are perfectly safe.

Convulsions. Cases of puerperal convulsion bear a strong analogy to epileptic fits; so much so, that it is nearly impossible to distinguish them at first sight, excepting from the different degree of violence attending each; the fit of puerperal convulsion being much more violent than any fit of epilepsy. The paroxysm is so violent, indeed, that a woman, who, when in health, was by no means strong, has shaken the whole room with her exertions.

Puerperal convulsions may occasionally arise at any time between the sixth month and the completion of labour; they seldom or never happen before the sixth month. They may arise as the first symptom of labour, in the course of labour, or after the labour is in other respects finished. Puerperal convulsions have these characters belonging to them: they always occur in paroxysms, and those paroxysms occur periodically, like labour pains; so that there is a considerable space, perhaps two hours, between the two first attacks; after this they become more frequent. They not only occur with the labour pains, but in the intervals; and whether there have been labour pains or not, before they come on we shall always find the os uteri dilated, and it is sure to become dilated from the continuance of these convulsions; and at length, if the woman be not relieved, and the convulsions continue without killing her, the child is actually expelled, without any labour pain at all: On opening such cases after death, where the convulsions have been violent, the child has been found partly expelled, from the contraction of the uterus; which power is capable of expelling it even after death. In one case in which it happened, the whole child was expelled except the head.

It is a disease depending on the uterus, and brought on by the labour pains; or, if arising before them, is of itself capable of expelling the child, if the woman survive long enough. It occurs in all presentations; sometimes with the first child, and sometimes with those born afterwards. It resembles hysteria, as well as epilepsy; but is more violent than either. No force can restrain a woman when in these convulsions, be the same woman naturally ever so weak. The distortion of the countenance again is beyond any thing that can be conceived: in regard to deformity, surpassing any thing the imagination of the most extravagant painter ever furnished; nothing bears any resemblance to the progress of this disease; the rapidity with which the eyes open and shut, the sudden twirlings of the mouth, are altogether frightful, dreadful, and inconceivable.

These convulsions are by no means external only; respiration is first affected with a hissing, and catching. The patient stretches herself out, and immediately the convulsion begins. The next symptom which arises comes on after the convulsive motions have continued in their utmost violence for a time; the woman foams at the mouth, and snores like an apoplectic patient, indicating great fulness about the brain. These symptoms are succeeded by a comatose sleep, out of which she awakes astonished, on being told what has happened, not in the least aware that she has been in a fit: and then she will fall into another fit, out of which she will again recover as before. It rarely happens that the understanding is taken away in this disease until it has been repeated several times. In the fit the skin becomes dark and purple, proving that the circulation through the lungs is not free, which purple colour leaves the woman gradually after the fit is gone; and it is not only the external parts of the muscles of respiration that are affected here, but the uterus also. This is known by introducing the hand; when the convulsions come on, the uterus will contract, but with a tremulous undetermined sort of force, perfectly different from what it does at any other time.

There are two cases of puerperal convulsions which are very distinct: one is a convulsion dependant on some organic affection of the brain; the other on an irritable state of the nervous system. Where puerperal convulsion arises from the former, but more especially from fulness of vessels, or extravasation, it is always preceded by some symptoms, which, if watched, will enable us to relieve, if the patient send in time, which however is rarely done.

In a patient strongly disposed to this complaint, there will be a sense of great fulness in the region of the brain, which amounts even to pressure, giddiness in the latter periods of pregnancy, dizziness in the head, and a sensation of weight when the head stoops forward, which gives her the idea that she shall not be able to raise it again; imperfect vision; bodies dancing before the eyes, sometimes dark, at others luminous. This state of the eye denotes fulness of the vessels of the head more surely than any other symptom, and if allowed to continue, will lead to extravasation and puerperal convulsion. The disturbed vision is a very strong symptom, and must never be passed over. If attended to early, even though symptoms of the complaint be present, still it may, by timely assiduity on our part, be prevented from ending in premature labour.

Here repeated bleeding and purgatives are all in all; the sole object being to take off stimuli. After bleeding, and before any aperient is given by the mouth, we should give a solution of soft soap in warm water as an injection; it is the quickest as well as the surest means; then a purgative mixture, with manna and Epsom salts. By these means, that is, by bleeding, purging, and the abstinence of all solid food and wine, no more blood is made; what the patient has is diminished, and she gets gradually better.

When convulsion arises from a general irritable state of nerves, it is difficult to distinguish the disease before it becomes established. It is most frequent in large towns, and in those women who lead the most indolent life; hence it is found in the first circles of fashion, in preference to the others; and there is one grand circumstance which has great influence in its production, that is, a woman's being with child when she should not. Being obliged to live in a state of seclusion from society for some months, perhaps she reflects and broods over every thing which relates to her situation, and which gives her pain. She recollects she is not to enjoy the society of the babe she has borne, but on the contrary will be obliged perhaps to part with it for ever. She is afraid of her situation being known, and that she shall be considered an outcast in society. In this way she will brood in solitude, till at last the mere irritation of labour may be sufficient to excite puerperal convulsion. The difference between this kind of puerperal convulsions and the other, does not probably exist in any thing visible: it is not possible to tell the difference exactly; but just as it is coming on, the woman will complain suddenly of a violent pain in her head, or stomach, which is expressed in the same way by all women: they all say they cannot survive the pain if it return. The mode of treatment will not essentially vary from that already mentioned. Our plan, however, should be less active, and opiates may be allowed to succeed it.

These observations relate to convulsions antecedently to labour. We now proceed to the same disease during labour.

It has sometimes happened that a woman has died of the first convulsion; but it happens much more frequently that a number come on in succession, arising either before or after delivery. The patient very rarely dies in the fit, though she die from convulsion; she dies in the comatose state which succeeds to the fit; and if we be suddenly called to a patient in this state, where we are unable to learn the circumstance of the case, and we evidently see there is a great fulness about the head, we should immediately open a vein, and draw blood largely, being regulated by the appearance of the body and what we are able to learn from those around. From twelve to twenty ounces may be the extent of the first bleeding; if the disease go on, and the os uteri do not admit of delivery from its not being in the least dilated, the convulsions not gone off, and the pulse in such a state as admits of it, we should bleed again, and again. Some practitioners have with the greatest advantage taken sixty ounces of blood in a day. A woman in this state will admit of divided bleedings very largely. This takes off the pressure from the brain, made by the blood while in its vessels; and also the chance of its being extravasated. This must be done immediately: then the head must be shaved, and a large blister applied over the whole cranium. The next means of relieving is getting the bowels into action as quickly as possible; first by throwing up a soft soap solution in the form of injection, and then by giving a concentrated solution of some neutral salt with infusion of senna.

If it be a case of convulsions depending on irritation, we may certainly do something more by the use of opiates; and here we must be limited in the quantity of blood which may be taken away. The proportion must be small compared with that proper in plethora. Eight or ten ounces will be a full bleeding; and if it be necessary to take more, we may apply leeches to the temples, never neglecting the bowels, which must be kept very open. It has been directed that the patient be put into a warm bath; but experience contradicts its use; the fits have been found to be more violent in it, and the patient is liable to bruise herself in it, and be otherwise much injured.

It is an extremely dangerous disease: it is impossible for her brain to bear the violent pressure of her situation; opium, in cases of irritation, is proper, and should be given to the greatest possible extent. With this we may join the affusion of cold water. This, when resolved on, must not be done by sprinkling a little out of a basin upon the patient's face; but we must have both a full and an empty pail, the patient's head being brought over the side of the bed; and before the fit has come on, we may, as in other convulsions, detect its approach, by attending to the intercostal muscles, the vibrations of which will warn us that no time is to be lost; when we should immediately discharge the whole over the head at once. Whenever this complaint occurs at or near the time of labour, it is uniformly right to deliver; to dilate the os uteri, and deliver immediately. We should deliver in all cases where it is practicable; for this is the only cure for puerperal convulsions.

If convulsions occur some days after labour, it should be treated as the same disease in other cases.

Rupture of the Uterus. This was formerly considered as a very rare occurrence, though it probably happened oftener than practitioners were aware of. We have many descriptions of sudden deaths in labour, the symptoms of which exactly correspond with those known to attend ruptured uterus. It may be divided into two kinds, spontaneous and accidental; the first happening most commonly in the cervix uteri, and the last in any part of the uterus.

Spontaneous rupture occurs suddenly and unexpectedly, and always without any warning, and for this reason, that it depends on the irregular action of the muscular fibres, and all muscular contraction is immediate. It most commonly happens, that when the head of the child is in the cervix uteri, the lowest segment of the uterus is received into the upper aperture of the pelvis, and the aperture of the pelvis without the uterus is opposite to the bones of the head within the uterus; the consequence is, that the uterus is pressed firmly between the two forces: from the pressure being applied in this situation, the longitudinal fibres can only contract from the pressed circle towards the fundus; and upon this principle it will not tear at the extremity, but will tear from the part so pressed upon; the rent once made may run in any direction.

Accidental rupture occurs from the action of the uterus being violent while the hand of the practitioner is within, or the same thing may happen from pressure of the knee or some other part of the child, which last is frequently the cause.

The manner in which the uterus gives way in this instance is exactly a fibre contracting over a pulley, which being a disadvantageous position, is liable to be ruptured if the contraction be strong. Certain symptoms take place which are evidences of its having happened; one is, a sensation of a sudden and most excruciating pain, which always comes on at the moment of the rupture. A lady, when in labour, was attended by a most respectable practitioner, and a man in years; this case is an example of the manner in which it may come on. The labour went on perfectly well, and it being late at night, he proposed that the husband should go to bed, as his wife would be delivered in three or four hours more. The gentleman then sat down by the bedside of his patient, and in about three quarters of an hour she began to scream suddenly: he supposed the head was in the vagina, as the labour had gone on so well, when, to his astonishment, he found the head was not to be felt, it had entirely receded. She would get up, and he in vain prayed and begged her to lie still. This state of pain and restlessness was succeeded by faintness from two causes, hæmorrhage and pain. These are attended with another, which is the sudden loss of labour pains. There is a faint inclination in the uterus to keep them up, but they are sure to sink. The organ is destroyed and its functions must necessarily be destroyed too. There is great restlessness, accompanied with a sense of pain different from that lately felt: there will be faintness, but without loss of blood externally, for it generally passes into the abdomen; there will be vomiting of a tenaceous chocolate coloured fluid; the head or other presenting part recedes usually, and the child can be no longer felt.

All these symptoms, combined, become a proof of ruptured uterus; but any one of the symptoms may occur alone; the patient may be in violent pain without rupturing the uterus; she may faint, but it does not follow that her uterus is torn; there must be all these things in common; excruciating pain, a fainting, sickness, and vomiting of that singular kind, and the retiring of the presenting part; these in the aggregate will determine our opinion. If in a case of this kind we find the head has only entered the upper aperture of the pelvis; we cannot get the forceps applied: here it has been said we might turn and bring down the feet: but this should never be attempted; it only occasions more mischief; the only change is to open the head of the child. If, however, from the head being high up, and loose, we think that we can embrace it with the forceps, we may try, for we by this mean give another chance for the delivery of a living child, which is a great object at all times.

Suppose a case where the child has actually retired from the cavity of the uterus into the cavity of the abdomen, what is to be done? there have been different opinions; some say it is best to bring the child back, while others leave it to nature. It should always be returned and delivered by the feet. The chance is something in favour of the mother, whose case cannot be worse, and largely in favour of the child.

Uterine Hæmorrhage. Flooding cases belong naturally to this section, hæmorrhage being one of the constant attendants on the last mentioned accident. We have already considered the history and management of trifling floodings occuring in the six first months of pregnancy, when speaking of the management of abortion: what we are now going to treat of relates to the three last months, the commencement of labour, during the progress of labour, or after the delivery of the child, and before that of the placenta; and each of these divisions, as regards time, will run into the rest.

Theproximate cause of puerperal floodings is in all cases the same thing, consisting of a partial separation of the surface of the placenta from that of the uterus. The difference existing in structure, between the human placenta and that of brutes, accounts for it happening less frequently in them than in us. In quadrupeds, the fœtal part separates from the maternal portion, as was before explained; while in us the whole placenta comes away entire, leaving vessels with open mouths; so that when any portion of the placenta is separated by any mischance, a consequent hæmorrhage attends, which is proportioned in violence and duration to the extent of the part so exposed. The vessels are largest towards the middle of the placenta; and some of them are very large indeed on the inner surface of the uterus.

The occasional causes of the uterine hæmorrhage may be any circumstance capable of separating a portion of the placenta from the inside of the uterus. These were enumerated when speaking of abortion: all acute diseases, passions of the mind, as rage, &c. strong liquors in large quantities; and besides these, if the placenta be attached close to or over the os uteri, it will be very likely to produce hæmorrhage, either before or in labour. When it is attached on the cervix uteri, it must in the course of the labour be separated by the dilatation of the uterus at its neck; this is so plain, that it cannot require illustration. Such a situated placenta will almost ensure uterine hæmorrhage in the last months of pregnancy, which may be more or less in quantity.

If it be very slight, the necessary means to restrain it need be nothing more than what is used in slight hæmorrhage from any other part: but when violent, and the patient either gets one gush of blood, or it comes in quantity till she faints, and then it is restrained, and she gradually recovers; and then it recurs from her taking some stimulus into her system, either food or drink; she has no sooner recovered a little strength, than another bleeding comes on, and she will faint and recover, and the flooding again recur, and so on; the faintness causing the restriction of the vessels; the restriction of the vessels allowing the circulation time to restore its own equilibrium; and when once that has arisen, the force of the circulating blood again overcomes the slight resistance formed by the contraction of the vessels, and the formation of the coagulum.

When once a woman has had an uterine hæmorrhage, from whatever it has proceeded, she is never safe; and must remain in jeopardy every hour, until she is delivered, for the slightest circumstance may reproduce it after it has once happened. The danger in this state is not from the quantity of blood lost, so much as the manner. A bleeding has come on at the third month, which was exceedingly large in quantity, but in consequence of its not flowing very quick, the woman has survived. Miscarriages occur, in which a large quantity of blood is frequently lost, without the woman dying; insomuch that where abortion takes place in the tenth week, she very rarely dies from loss of blood, though sometimes this is excessive. What then does this depend upon? the time in which it is lost, and the way in which it comes on; for although lost from the constitution, it is from small vessels. But when there is a sudden gush of blood from large vessels, the case is quite different. From experience we know that large vessels do not contract so soon as small ones; there is not time for faintness to intervene, and the patient consequently dies immediately.

One symptom of the greatest danger in a flooding case is a want of labour pains, when it occurs in labour, which is the reason that the midwife hardly ever sends for us till it is too late; she thinks nothing can be necessary to be done till the pains go on as they should do, while in fact their subsiding is one of the worst symptoms. It shows that the uterus has not energy enough left to expel the child; so that we always judge uterine hæmorrhage to be worse when not attended with pain than when it is. Another bad symptom is, when the os uteri feels relaxed and flabby like a piece of dead meat, with a hole through the middle of it. It resembles an inanimate opening: we may without resistance move its lips in any direction. When the hæmorrhage continues long, the face loses its colour, the mouth and lips become quite pale, and the little projection at the inner canthus of the eye is a very significant part with an attentive observer; it is not often attended to, but, if it be sunk, it is a symptom of decided danger; these are followed by want of rest; the patient will be moving about in bed, and that notwithstanding all that we can say, if we even represent the risk of her producing her own death by it, still she will be throwing her arms in every direction, and rolling backwards and forwards in the bed. In this way then will she proceed, one fainting succeeding another, at last so rapidly, that it can scarcely be conceived until seen; fits of vomiting towards the end will occur, together with a sort of convulsive raising and lowering of the pomum adami: and life will at last leave her suddenly; perhaps after she has been speaking she will lay her head down and die. Ths next danger is, that she may drain to death, by a slow progressive state of the complaint. To-day she shall lose a pint of blood, to-morrow half a pint, next day none, the day after that again a quart, and so on, till the powers of life are exhausted. Thus is she drained to death; for the stomach is not capable of supplying nourishment quick enough to counteract so rapid a consumption.

There are still other dangers arising from uterine hæmorrhage, the consequence of which we have great reason to fear. Suppose a woman in labour loses two quarts of blood by the vessels of the uterus, that woman will, about the fourth day, have a perfect fever in all its characters, somewhat resembling the milk-fever, the pulse 120, the countenance flushed, the skin hot and parched, though we should naturally enough expect, that instead of producing fever, the loss of two quarts of blood might more readily be expected to take fever off where it existed before. Supposing even that the patient gets quite clear from any return of the hæmorrhage, the fear that remains is, whether she have not already lost too much for the constitution to repair; and we must again wait in expectation of the fever; if that do not come on, so much the better; that is another danger got over. But she may die at the end of twelve months, and that from the effects of a single attack of this complaint. This will in most instances happen in women who are of a flabby loose texture, and have a heavy fat body. Hydrothorax, or ascites, will in these persons supervene at a great distance of time, entirely from the debilitating effects the loss of so large a quantity of blood has induced.

With regard to the powers by which hæmorrhage is naturally restrained in different parts of the body, we may say that they are two in number; one of which is the contraction of the blood-vessels themselves, the other is the coagulation of the blood in the mouths of the vessels which are ruptured. With regard to the contraction of blood-vessels, it is well known that an hæmorrhage is frequently stopped by that power alone. If we prick our finger, or shave a bit off, it would bleed everlastingly, were it not for the contraction of the divided branches, which stops it, and that so effectually, that if from time to time we even wipe away the blood with a sponge to prevent any assistance which might arise from the formation of coagulum, yet the bleeding will stop. But as the vessels contract gradually and slowly, the blood which forms on the surface being exposed to the air coagulates, and becomes the second cause of the blood ceasing to flow from the divided vessels. So that hæmorrhage, considered in general, may be said to be restrained partly by the contraction of vessels, and partly by the coagulation of blood in the vessels. The natural powers by which hæmorrhage is usually restrained are, the coagulation of the blood as it flows, and the contraction of the vessels. To these a third power is added in the uterus; it is the contraction of the organ itself, and it is not only one of the three, but the most important, as being the most effectual power of them all, in stopping the hæmorrhages which flow from the internal surface of the uterus. It should appear also from the experiments of Hewson, that the coagulation of the blood is more rapid in animals when dying than at any other period; hence he argues that coagulation is always in proportion to necessity.

With regard to *treatment*, we may observe, that in slight cases, where the quantity of blood lost is very trifling, it will not be necessary to notice the existing state of pregnancy, but to make use of the common remedies for the checking of slight hæmorrhage from any internal part. But if there be increased action of the heart and arteries, and we know the constitution will bear it, we may take away ten ounces of blood, and suppress the animal food; moderating the sanguiferous action, so that there shall be no risk of displacing the newly formed coagulum, in its recent state a tender jelly. If these things are attended to, the blood will perfectly cork up the bleeding orifices of the ruptured vessels. We should at the same time empty the bowels, prohibit all stimulating aliment, and advise a horizontal position. All this, however, refers to slight cases, and an early period; if after this period, or during labour, we must seldom be beguiled from more active measures. The only solid security is a delivery of the child, which in all cases of profuse or continual hæmorrhage we should immediately prepare for; and in the process to be pursued we are of course to turn the child.

Wherever, in doing this, the os uteri very easily gives way, it is the very essence of danger, proving the want of contraction in the uterus. In the present instance, however, we do not want to empty the uterus so much as we wish for its contraction; for if we get away its contents at a time when it cannot or will not contract, we do no good. If the placenta seal up the os uteri, we must go directly through; we may easily indeed, screw our hand through it, for it is a loose pulpy mass easily torn. We should not wait long, nor be afraid, and, if the labour be recent, we may turn the head and bring down the feet: if the head be low enough to apply the forceps, we may deliver in this manner. The whole of this practice lies in a very small compass; in determining to deliver early, and in determining that our patient shall not die; and it is founded on the principle that hæmorrhage from the uterus cannot be restrained by the two powers which are sufficient for stopping a flow of blood in most other parts of the body, by the contraction of the vessels, and the coagulation of the blood in them; and that nature has here appointed a third power, by the presence of which the human uterus differs from that of all other animals. It is right, however, after turning and bringing down the feet, to allow the child to remain undelivered for a short time, attending to the least pain that may be felt, and gently assisting in the forwarding the expulsion; and when the child is born, to wait the action of the uterus again for the expulsion of the placenta; for we must still recollect, the grand object is the contraction of the uterus, without which, its being emptied would produce very little good. It will then happen that the same contraction which expels the placenta will diminish the area of the vessels, and the danger from flooding ceases. But if this contraction do not take place soon, and the hæmorrhage continue for some minutes after the extraction of the child, we must consider whether the strength will not be lost, and the safety of our patient endangered; if so, the hand should be introduced into the uterus, not forcibly to bring away the placenta, but by its presence to cause the uterus to contract. The application of cold to the abdomen will greatly assist in promoting the contraction. The placenta should be gently detached, and when the uterus contracts, both the placenta and hand will be expelled.

Immoderate Discharge of the Lochia. The next view of uterine hæmorrhage is that where it does not stop on the extraction of the placenta. Such cases as these are very rare; there may be a sudden gush of blood, and often is, following the placenta; the reason of which is, that the uterus, at the time it expels the placenta, forces down every particle of blood with it; and in this way, a pound or a pound and a half may escape, but that need not be regarded in the least; it does not affect the constitution, because it was not evacuated immediately from vessels; it was lying in the uterus. So when we amputate a limb, there is no loss of blood to the constitution, because the whole of the blood which is taken away is necessary to the limb, and no longer necessary than while the limb was to be supplied. But supposing that, from the vessels not being properly secured in the operation, there is a bleeding afterwards from the stump; then it is that the constitution suffers; there is a demand made upon the mass of circulating fluids, which must be replaced before the heart can recover its proper balance in the system. Apply this to the uterus, and we shall consider the blood as belonging to the gravid uterus, and not to the circulating system. This is what is, in the practice of physic, called an immoderate discharge of the lochia. Such hæmorrhages frequently arise from the cord being pulled with too great violence, by which the placenta comes to be injured; and this happening when the uterus is not disposed to contract, the vessels will, for a time, remain exposed, and bleed. This is the reason why it happens so frequently in the hands of bad practitioners as midwives; and that it is so rare when no improper treatment is adopted in regard to the placenta.

Now supposing the hæmorrhage yet remains, that is, after the uterus is emptied, the child born, and the placenta come away; what are the means next to be employed to restrain the hæmorrhage? the application of cold, and the abstraction of heat, in every possible way; we should take the clothes from the bed, leave nothing but a sheet to cover, and that from motives of decency alone. If there be a fire in the room it must be put out; the windows kept open to preserve a cool and fresh air, and if the patient be faint she may have a cup of cold water.

Cold water and ice are the proper applications both to the parts themselves and the body round them. The coldest water made colder by throwing two handsful of salt into a couple of quarts of it, may be used by cloths many times doubled dipped in this, and laid over the back and abdomen; besides which, we may with the greatest advantage expose the body to a great degree of cold, if it can be done.

If these means do not answer, we must introduce ice into the vagina, or even uterus; this will often succeed; if this be ineffectual, we must, as the last resource, plug up the vagina with lint or tow, or something capable of entangling the blood; for while there is a clear channel there will be no coagulum formed. If the flooding still continue, the best plan is that of carrying something permanently cold into the uterus itself; a large dossil of lint, dipped in the cold solution, will carry up a degree of cold: but the best thing is to carry up a piece of ice, and allow it to thaw in the uterus. Dr. Baillie, of New York, who was the first who introduced the use of cold applications here, was in the habit of using a ball of snow for this purpose, which often stopped it directly, when nothing else would. Ice being introduced into the vagina, will often prevent abortion; this then is the best and last remedy in floodings; if none of these things will stop it, there is nothing else that will.

After the hæmorrhage has ceased, the patient will be so reduced, so exhausted, the action of the heart so weak, and the quantity of blood circulating so deficient, that our first care must be to supply the waste, and remove the greatest danger, which is that of the patient's having been exhausted beyond the point at which the constitution is able to rally, and recover itself. These cases must be supported and stimulated; boiled milk, with grated crumbs of bread in it, must be quickly cooled by spreading it on a flat dish, and when cool may be given as one of the most nutritious things that can be had; or good broth in which the grated bread is mixed; and if these remedies do not stimulate the heart and arteries, the probability is, that the patient will die. In many of these cases the best stimulant is the volatile alkali, next to which brandy and water, or the ammonia, which is preferable, because, although the first effects of the spirits is good, it produces too much heat in the system at large, while that effect never arises from the volatile alkali. It is sometimes two, or even three hours, before we can leave such a patient in the certainty of her living.

After the flooding has stopped, we are not to consider the patient as safe. The fever coming on about the third day, may be troublesome; nothing is so efficacious for this as the saline draughts, with laudanum to the amount of a grain of opium in the twenty-four hours. Immersing the hands and feet in warm water to about 80° Fahrenheit is useful; it brings down the pulse, and does a great deal of general service.

After flooding, another circumstance requires attending to, a throbbing of the head and loss of memory, which will remain for weeks: in such cases there is nothing so good as purging, although the cause of the complaint be hæmorrhage. The best way is to give infusion of senna with the Epsom salts, after which a draught of the decoction of bark.

Consequences of the Placenta remaining, and its treatment. The general treatment of the placenta has been already explained, where nothing more than ordinary attends it, together with the proper time which it may be allowed to remain. We will now consider the consequence of its remaining, and its treatment when it does remain.

It was said before, when it remained too long, it was necessary to pass up the hand, and bring it away by separating it from the uterus. Some say, that immediately after the child is born, we should go up and bring it away, if the same pain which expelled the child do not separate and bring down the placenta. This is said to save another unnecessary pain. It is said that the uterus will afterwards contract, and all will be well. The truth is, the uterus is meant to expel the placenta as well as the child: if it were necessary to have extracted the placenta directly as the child was born, nature would have made some further provision: all the works of nature are perfect in all their parts. There is a case in Haller where it was left to nature, and remained, it is said, thirty days. We should never think of leaving our patient while the placenta remains behind. When a woman is properly managed, it will rarely be necessary to separate with the hand. In this Dr. Hunter's practice was exceptionable; he was in the habit of leaving this to nature: he used to leave the woman upon the child's being born, desiring the nurse to put the placenta into the basin when it did come away; that was enough for him.

We should never leave the placenta in the uterus; and if we have left it two hours, we should never leave it beyond that time. It is always right to bring it away. If it adhere to the uterus, we may introduce our hand as in turning, guiding the hand by the cord; we should then separate the edges of the placenta from the uterus, peeling it gradually and carefully off. After the whole is separated, we may make a feint to withdraw our hand to observe if the uterus will contract; if it do not, we should use a degree of pressure against its side, and it will generally bring on its action.

The placenta may be retained by a contracted uterus, of which there are two kinds, one in which the uterus is as long as before delivery, but narrower. This state will depend on too speedy delivery. We must patiently overcome the contraction with our hand, and separate and bring away the placenta, as in other situations. There is little hazard in this case, as the ready contraction gives us little reason to fear the ill effects of hæmorrhage after we have got away the placenta. The other sort of contraction is that in which the uterus may be said to resemble an hour glass, called therefore the hour glass contraction; this must be overcome in the same way as the other. Whenever we introduce our hand to bring away the placenta, we must take care to bring away the whole; it has been stated that a part of it has been found in a state of scirrhous adhesion to the uterus; now it certainly will adhere, that often happens: but of scirrhous adhesion we know nothing. However, we should always do a thing perfectly: if we set out with the intention of doing it at all, we should do it completely. It is better to leave the whole than a part; because, if the whole be left, most probably the uterus will contract upon it, since it is a stimulus which the uterus is able to act upon, while part of it cannot be acted upon by the uterus with the same facility.

Consequences of a portion of the placenta remaining. Pursuing the subject, we come next to the consideration of that state which arises from a portion of the placenta being left. No great inconvenience seems to arise till the third or fourth day, when the lochial discharge increases and becomes more offensive; the after pains, which generally cease about the third day, remain after that time, arising from the tendency in the uterus to throw off what it cannot get rid of. There is occasionally a shivering fit, succeeded by heat, but rarely ending in perspiration. The pulse rises to 120 or 130, the patient becoming emaciated and very pale, though when the fever is upon her she looks as if painted: by degrees the hectic flush lessens; the pulse becoming smaller, acquires a wiry hardness, and this continues: the woman becomes tender at the lower part of the belly when it is pressed upon, though it is not violent pain as in puerperal inflammation; frequent retching and vomiting now arise; and if she live long enough, hiccup succeeds to the last symptom, together with which the mouth and tongue become sore: she is at length worn out by all this, and lays down her head and dies.

The discharge becoming greater and more offensive is the best marked symptom, and frequently causes the death of the woman. This does not strike those people who happen to attend without being practitioners in midwifery; they see the fever, which they attribute to the effects of lying-in, and they hope it will soon get better.

Inverted Uterus. This happens most frequently in the practice of female midwives, they being more in the habit of pulling away the placenta: and they in this way invert, upon the same principle that the finger of a glove is inverted when a string is passed up the inside knotted to the end of the finger, and then drawn down the interior.

In pulling at the cord it will often happen that the placenta will separate from the uterus at the same time that the inversion takes place, and the operator is not aware of what has happened; now, however this is produced, the effect is in all cases the same; it may be attended with profuse flooding, or the uterus may contract; it is lucky if a flooding come on, since it may lead to an examination, when the tumor will be felt in the vagina, and must be returned, the fundus being reduced first. It should be done as early as possible. The difficulty consists in the os uteri forming a sort of ligature behind, which prevents the return of the uterus through it. When the os uteri is before us it is easily dilated; but when we have to work through a substance to it the case is changed. Sometimes hæmorrhage will take place early after delivery; and whenever it does, we should always examine: there is no difficulty in examining, and it ensures the safety of our patient. If we know of the case directly after it has happened, and we return it, there is an end of the mischief; but if we neglect to ascertain its existence till the next day only, we stand a very fair chance of losing our patient: it will be hardly possible to reduce it unless attempted directly. It is then of the utmost consequence that the practitioner be careful in extracting the placenta; and that he never pull the cord forcibly, till upon passing his finger up the vagina he feel the root of the placenta; for he may be then satisfied that it has separated.

Reviewing then what has been said upon this division of labours, we find that it comprises difficulties of two descriptions; the one resulting from what has been called cases of arrest, or of impaction: and the other from merely collateral circumstances. It is rarely that the aid of instruments can be of service, or even employed in the latter description: while they may very frequently be of the utmost assistance in the former. We call it a case of arrest when the head is got down into the pelvis, and remains unmoved, not because there is too much resistance, but because the woman is too weak for any further exertion. The state of things in arrest is very different from that which happens in impaction; in arrest we find the head not compressed, nor the scalp drawn into folds or swelled; the stools come away naturally, and the woman makes water easily: and with regard to the constitution it is languid and weak; in short, she is a very debilitated woman. What then will be the consequence in this view of the case? Is the woman likely to overcome the difficulties now the powers are worse? No. Is there any danger with regard to the constitution? No. While there is a number of little pains which last four or five days, is it right to leave a woman? No. Then why not deliver her with the forceps, in which there is no danger? It is only bringing along the child, while the mother has not sufficient power to do it herself. In a case of impaction the powers of a woman may be as good as those of any woman in the highest health. But there is a resistance which cannot be overcome, so that things are very differently situated to what occurs in arrest only. The bones of the head are wrapped over each other, the scalp is swelled and wrinkled, and is so altered, that upon any person feeling it who had never been at a labour, he would guess it to be any part but what it is. If it be a genuine case of impaction, the head will be locked in the surrounding parts, producing a stoppage of the evacuations of stool and urine; so that on this account it would be clear that the head filled the aperture of the pelvis.

In the next place we must attend to the constitutional changes. For the first twenty-four hours after being taken in labour the woman works away very vigorously; while during the last twelve hours the labour will hardly make any progress, and she is sweating extremely. This state will at last change; it will gradually sink down to a mumbling half delirious state, wandering and low. No woman should be allowed to go in this state; and if she be in such a situation, she should not be allowed to remain in it. For if the pressure of the vessels upon the brain be allowed to continue, she will become apoplectic. Besides, there will be harm done to the abdominal muscles. What good will be done by allowing the woman to deliver herself, if the vagina and bladder slough with the parts around, which is another thing that may happen? In a consultation that was held in a case of this kind, it was agreed that nature certainly should be able to deliver the woman: she therefore was not interfered with; she did deliver herself, but lost her life for it; she died, and that at a time when an ear was to be felt, which certainly was a piece of barbarity. It is safe to assert, that if, after we are able to feel the ear, the woman is not delivered in six hours, we ought always to deliver with instruments. We know that in strangulated hernia nature has, in one case out of 50,000, made an artificial anus through the side, after the parts themselves have sloughed off. But are we for that reason to avoid operating for the strangulated hernia? Are we to leave the patient to the powers of nature? There is not any difference between pushing a man into the water, and not helping him out of it, if we see him drowning; neither in the same way is there any difference between destroying a woman purposely, and neglecting to employ those means, which, when she is in danger, will certainly save her life. There are many other cases in which the forceps may with propriety be used: hæmoptoe, syncope, flooding, presentation of the navel string, rupture of the uterus; all these occurrences justify its application, provided the case is within the power of management by these means, either forming impaction or arrest.

We proceed, therefore, to examine into the origin and nature of the instruments usually and advantageously employed on such occasions.

ORIGIN AND USE OF INSTRUMENTS.

Some time towards the latter end of the century before last, two instruments were invented; the vectis, and the forceps.

The *vectis* is what the name implies, a lever which is intended to assist the delivery of the child's head. The forceps consists of two levers joined to each other in such a way that the fulcrum of each blade is found in the opposite half of the instrument.

In employing a lever there are three points to be considered; the point of action, the moving power, and the fulcrum or intermediate space between the two. In using, then, the vectis, the point of action is the head of the child. And here it is too obvious to need mentioning, that the force applied by the instrument must be equal to the resistance, if not superior to it; and then the mischief may arise to the parts of the child's head so acted upon, producing much injury: the ear may be injured; the lower jaw or zygomatic process of the temporal bone may be broken; or any part of the surface from the pressure may slough off: these evils are by no means imaginary; there are various instances recorded of each of them, and that under the hands of the most careful and dexterous men. When an instrument of this sort is used, it is proper to make the hand the fulcrum on which it acts: now if the force required be but small, this may certainly do well enough; but where great force is required, this is a very bad support; besides, the bony parts of the pelvis lie so convenient, that we may rest our instrument on almost any part of it; yet we should recollect, that whatever part we convert into a fulcrum, we injure more or less, according to circumstances: if we apply it over the symphysis pubis, we press upon the urethra; or if in other situations, we shall injure the clitoris, or vagina.

Wherever we find the ear, over that part is the application of the instrument to be made. The injury done to the soft parts will be greater in proportion as we attend less to their safety than to that of the perinæum. The integuments suffer again, if we attend to the fulcrum, by which we get a lacerated perinæum. So that we either cannot use much force with the vectis, or, if we do, it will be to the certainty of doing much mischief. All these circumstances will depend, however, on the smallness of the difficulty to be overcome; and if there be no great danger, there will not be much difficulty or pressure.

The *forceps* has many advantages which are of some consequence to mention. The forceps has thinner blades than the vectis, and one objection against the use of the last instrument is, its being so very liable to do harm at its point of pressure; while another objection is, that as the force is applied higher up, so it makes the head flatter in proportion, and increases its volume in the direction in which it should be lessened. In the next place, if we consider the vectis, we find, that whenever its pressure is applied to the upper part of the pelvis, it must increase the volume of the head applied to the lower part of the pelvis; while we know that the forceps, so far from increasing the size of the head itself, is capable of compressing the head in such a manner as to bring it into a less compass than before; so much so, that the head included in the blades of the forceps shall altogether occupy less space than was before occupied by the head alone. It may here be objected, yes; but the head is compressed by this means. Yet, granting that it is, we know that at the same time the child is able to bear that compression without the least injury. Besides, the practice is justifiable upon other grounds than that of the pressure not hurting the child: for suppesing that it did hurt the brain, no more force is used than what is necessary to bring the head along the cavity. It is only compressed to the size of the pelvis, and at any rate it must come through that cavity, therefore it must inevitably suffer that compression, whether conducted through by instruments, or forced through by the labour pains of the woman herself. There are cases where the head, being actually too large for the cavity of the pelvis, would never get through by the exertions of the woman alone. What is to be done here? if no other resource be at hand, we must open the head: but here the forceps present, to save the child's life by the compression they are able to make. The truth is, that the brain of an infant will bear pressure very well, so that as far as this goes, the forceps may always be very safely applied. We see that they do not act by any partial pressure, and that the action is diffused.

Another objection to the use of the vectis is, that it requires one of the hands to be employed as a fulcrum, in order to prevent injuring the soft parts against which it would otherwise rest: and that while the hand is so employed, the perinæum is neglected to the hazard of its being lacerated; and that if we chose rather to take care of the perinæum, the soft parts are violently pressed against the bone, by which they suffer great pain and injury.

The forceps consists, as we have already said, of two levers joined to each other in such a way that the fulcrum of each blade is found in the opposite half of the instrument; and now having two levers united by a joint, we need not look to the pelvis to furnish the fulcrum, neither need we neglect the perinæum. There is still a query, that if the forceps be so much better than the vectis, how is it that the vectis is still in use by some? for no other reason than because it is easier to use; for one instrument requires less skill than two, and for that reason it is preferred by those who have not more skill than they know what to do with. They say they think it is best, and with them so it is. The man is simple, the instrument should therefore be simple. The complex instruments are safer in the hands of those only who have learned all the uses of them as well as the modes of managing them. Though, as to instruments of every kind, the knowledge of them and the way to use them dexterously can never be taught; they must be used before the management of them is acquired. It is only learned by practice; just as the habit of stopping the notes correctly on a stringed instrument of music.

In the *Application of the Forceps* we must first learn the state of the pelvis; if that be narrow or deformed, we next calculate whether the head can pass; if it be too small, the forceps is useless. It is best never to apply it, but when we are able to include the whole in the grasp; to ascertain which, we should examine and feel the ear; when we can feel an ear, the head is within the cavity of the pelvis. The reason why we know the forceps may be then applied is this, we know the instrument to be so much longer than the finger, that if from the os externum the latter be able to reach the ear, the former will effectually encompass the head. The next thing after feeling the ear, is to ascertain the exact position of the head, which being done by examination of the sutures and fontanelles, we judge whether a change of position in the head might not enable the woman to expel the child by her own powers alone; and if we find ourselves unable to turn the head round, we may then apply the instruments to it as it lays; first feeling for the occipital bone and fontanelle; and if in examination we be able to feel the posterior fontanelle, we know that the occiput must be somewhere in the range of the pubes, which will be more precisely determined by the direction of the sagittal suture.

Supposing this known, the instruments are to be applied, the convex sides of the blades to the cavity of the sacrum, so as to accord with the direction of the axis of the pelvis. Before the introduction of the forceps, it will be necessary to dilate the parts gently, especially if it be the first child. The blades of the forceps must be greased before being passed, to ensure an easier passage, and then one blade first is passed gently up between the finger and the head of the child; because by this means we are certain no soft parts can be injured, or pinched by it; further than the finger will reach we must depend on the proper direction of the instrument, which should at its point be pressed towards the centre of the head, and passed forward with a gentle riggling motion, which serves to form itself a space between the uterus and the head, taking care also to keep the handle of the forceps outward, so that we may assist our intention of keeping the point of the blade close to the head. In carrying the instrument up, we should always put the woman upon her guard to warn us if we give her much pain, because if we do, we know that we have pinched the uterus, and should then withdraw the blade a little way, and return it till we get as far as necessary without much pain; which being done, the other blade is to be introduced in the same manner; which is easily accomplished after the introduction of the first. Both blades being introduced, the instrument is next to be locked; and it is convenient to pass the finger several times round the lock, to see that no hair or skin is included, which might give some uneasiness to the patient at the time of using the instrument; and before beginning to operate it will be as well to take the forceps, and give it a sort of vibration or shake, that we may feel that we hold the child firmly. We should then explain to the patient, that every thing relative to the application of the instrument is done; but that she must not expect our assistance will give her no pain, for it must give pain, though less than she would feel in her attempts towards expulsion while unassisted. It is not possible to bring the child into the world without pain.

Now we must remember that labour pains are not continual; therefore we must not use the forceps as if they were. The head will not bear constant pressure, therefore we must desist every now and then, beginning with the least possible force that is of any use, which may be easily increased as may be necessary. We should rest frequently, and from time to time go round the head with our finger, to see how the business comes forward; always satisfying ourselves that the instrument still encompasses the whole of the head. The motion we make with the forceps must be slow and gradual, inclining it very gently from side to side, or from blade to blade: always acting in a line with the axis of the pelvis, till we can feel the occiput when we move with regard to the axis of the vagina; using in the latter part of the operation very little force, for the head requires very little force to bring it through the vagina.

Deformed Pelvis from Rickets or *Mollities Ossium.* In both these diseases the cavity of the pelvis is often so much contracted, that it is impossible for the child to be brought down it whole and alive by any means: and hence when we meet with deformity from either of these sources, our first question should be, whether there be space enough to allow the child's head to pass? and if the space be above three inches, it is sufficient, and the head may pass. Where it is less than three inches it is not sufficient, and the head cannot pass; the question is then changed, what method have we to bring the child out of the body, if it cannot pass through the pelvis? and here it has been proposed to cut it out from the body, by the following operation.

Cæsarian Section. This has been performed in two ways, by an incision obliquely carried through the side, or through the linea alba directly down. The object proposed in this operation is to save the life both of the mother and child. It is of great antiquity. It is said that Julius Cæsar was taken this way out of the body of his mother; but there is no just ground for believing such a report; many historians held him as so remarkable a man, that they were determined he should not come into the world like any other person. If it had been so, is it not strange that Pliny, who wrote so soon afterwards, should devote a chapter entirely to the history of a living child being cut out of the body of the parent who was dead, and yet mention nothing of Julius Cæsar's having come the same road. Scipio Africanis is said to have been introduced by the Cæsarian section, but there is no reason to believe it. It was never known otherwise than as an operation recommended till the sixth century in Paris. It was also once performed in Holland by a sow-gelder upon his wife. It is remarkable that the same woman was afterwards pregnant; but when her husband proposed the operation again, she declined submitting to it, and was delivered without. The surgeon who strongly recommended it in Paris, was Rousset, who never lived to see it performed, on account of the opposition he met with in opinion from Ambrose Parée and other eminent surgeons.

The manner of performing this operation has been much disputed; the lateral incision appears to be the best; because we divide one muscle, and it retracts, we divide the muscle under it, and it retracts also; but the whole of the incision will not be a direct line through, so that we stand a better chance of saving our patient, as far as exclusion of the air may have a good effect, when the parts come afterwards to unite.

Of the two plans of performing the operation, the lateral incision then appears to be the best, and in making it we must attend to the following points: the woman may die under the operation itself, or shortly after, from the loss of blood; from exposure of the cavity of the abdomen, causing extensive peritoneal inflammation; from the parts suppurating instead of uniting by the first intention; or from inflammation being so violent as to prevent the formation of matter producing mortification. Yet if we look at the cases of this kind that are recorded, we shall see the fairest accounts that could be written, the death of the patient never being attributed to the operation, but to some trifling cause, perhaps relating to diet; such as a small glass of wine or a few grapes producing inflammation of the peritonæum, or diarrhœa. This is decided upon, without considering the probability that the diarrhœa or peritoneal inflammation may have been produced by the operation alone. These things should be considered fairly, and not viewed with the partial eye of him who has performed the operation. We see that on the continent this operation has been very rarely successful, according to Bourdelet, not in one case out of ten: and when we enquire how often it succeeds in our own country, as more nearly concerning us, we find that it has uniformly been fatal, that is, that all the patients have died from it; there is not a single solitary instance of recovery. It has been performed in London, Leicester, Edinburgh, and Manchester, by the best surgeons of these places, and there are none better in the world; but all the patients have died. Nevertheless, whenever the operation is performed it should be done with a view of preserving both lives, because it is a safer way of delivery to open the head of the child. In mollities ossium, indeed, the disease is continually going on; no case recovers; it always destroys the woman: and here it is certainly advisable to perform the Cæsarian operation, though not with the hope of preserving both lives; but that the woman is hardly more sure of dying after the operation has been performed, than she was before.

In all cases of mollities ossium, then, the child being ascertained to be alive, the Cæsarian section should be performed; in all other cases the life of the child should give way to that of the mother, and the head should be opened.

Signs whether the Child be alive or dead. From the reluctance that every one must feel in opening the head of a child, it will be still a satisfaction to us to know whether it be alive or dead. The marks, then, are these: in the first place, supposing the child is alive, the pregnancy of the mother will continue to increase to the end of her time; and in labour the presenting parts will have a firm elastic feel; the cuticle and hair will not come away on the finger: besides which, there will generally be a pulsation at the fontanelle. But the navel-string being pressed may cause death; it may arise, and does often arise, without any cause that we are able to trace. We know that a child may die in utero from affections of the mind in the woman. The death of the child may be known by shivering fits preceded by a sense of coldness in the abdomen. While the child is alive, it assists in supporting its own heat; but when dead, it necessarily must obtain a degree of heat by robbing the mother of part of the heat in the parts around, which explains the sense of coldness that is felt. The breasts, while the child is alive, increase, and continue firm and well supported; but when the child dies, they immediately become flaccid and empty. So that a woman, frequently used to miscarriage, will foretel its approach by this alone. While the child is alive, it gives the sensation of a living weight, a weight which is capable of adapting itself to the different positions of the mother; but when death deprives it of this power, the woman feels it flap from side to side, according to the way in which she moves. She becomes sensible of weight to a much greater degree than before. Besides all which, there will be the cessation of motion in the fœtus, which is always perceived by the mother some months before delivery. These are so many signs of the child's death, which may be observed before labour comes on.

There are others which accompany labour: first, as the child is dead, the membranes will be dead also; and for that reason will break earlier than they otherwise would. It has been said, that the liquor amnii being turpid, points out the child being dead; but this circumstance sometimes arises while the child is alive and well. The strongest sign is one by which we may tell it before even we see the woman; it is by the waters being corrupted. The smell of putrefaction will sometimes decide the opinion of an experienced practitioner the instant he enters the door; also in examination, from the meconium coming away on the hand, in consequence of the spincter muscle being putrid and relaxed. The sutures of the head vacillate like bones in a bag. When we examine, the hair and cuticle will come away upon the finger.

When all, or even the greater part, of these signs are united, there can be no possible doubt that the child is no longer alive.

In what cases the Child's head should be opened. These cases are syncope, convulsions, hæmorrhage, on the part of the mother; hydrocephalus internus on the part of the child. This last disease may be ascertained by examination, the sutures and fontanelles being at a greater distance than they should be, and the whole cranium very imperfectly ossified; but the most unequivocal evidence is the head's not entering the pelvis; by which we know that the head is too big for the pelvis, or that the pelvis is not large enough to receive the head into it, which is the same thing in effect.

When all the stages of labour are gone through, and the head is not advanced, we are led to examine and find out what the state of the child is. When we have ascertained the existence of a deformity of pelvis, we may generally tell the space left for the child's passage, by passing the finger from before backward; that is, from the vagina; the space under the arch of the pubes, backwards and rather upwards, towards the projecting front of the sacrum, where the first lumbar vertebra rests on it. Now, in a well formed pelvis this cannot be done; it is not possible to reach the sacrum in this way; but in a deformed pelvis we may ascertain the space pretty accurately; when the distance between the projecting part of the sacrum and the symphisis pubis is upwards of two inches, the delivery is very simple; it would be well if it were less so, as then it would not be so frequently adopted as at present. Many a practitioner has sacrificed a child's life at the shrine of his own ignorance. It is much easier to apply the perforator and open the head of the child, than it is to apply the forceps; in the latter some considerable skill is required, in the former none.

In what manner the Head is to be opened. The necessity for this operation being manifest, we must proceed as follows. First empty the bladder, then throw up an injection, that the rectum may be also cleared; next, introduce the hand into the vagina up to the os uteri, upon which we are to pass the perforator, guarding the point with the utmost care, while passing it by means of the other hand purposely introduced before the instrument. The points of this instrument are guarded by stops, by which, when we push the points through the child's head, we avoid the danger of their passing too far, and by coming through the opposite side of the head, of wounding the uterus. The way they are used is this: we bring the points upon a suture or fontanelle, recollecting that when they are introduced, the handles are close together, and consequently that both the points form one perforator; now when, by the hand in the vagina, we have laid the points opposite the part of the head we intend to open, we press the instrument down with force sufficient to make it pass through the integuments, which, being done, and the perforator pushed in up to the stops, we are next to lay our hand between the handles and pass it up between them to the joint. The effect of this will be, by its acting as a wedge to force asunder the points, and to dilate and tear open the sides of the wound before made; we next close the sides of it and change its position, so that the handles will have their rings in a horizontal position; we then open the instrument again as before, which gives us a cruciform opening. This being done, the perforator is next to be pushed into the head, and screwed round backward and forward, so as entirely to break down the consistence and connection of every thing within the skull; this will generally be sufficient, the pains will quickly press out the cerebrum, which may be removed from time to time; or we may scoop it out with a table-spoon.

If the pelvis be not greatly deformed, the delivery may now soon be effected; if it be, we proceed to remove the bones piece-meal, taking care to guard each piece through the vagina, by laying the scabrous edges of it against the hand, which during the whole operation should be in the vagina. The sides of the two points of the perforator, which come against each other when the instrument is shut, are made rough, so that as with a pair of pliers we may take hold of a bone which is too large to pass, and break. In this way we must bring away the frontal bone, and occipital bone; the temporal bones, and the parietals; after which, in order to have a firm hold, we should lay the scalp as far over the parts within as we can, making a sort of flap to lay hold of. It is best to put on a glove well-greased in order to catch hold with. It will sometimes answer very well to carry up the blunt hook, with which we may occasionally be able to catch hold somewhere, so as to have a good purchase; but it is very apt to slip, as it has no point. If it do slip, we can then only pass the crotchet, in the construction of which we should observe that the flat point, at its sharp extremity, looks inward; so that if laid to a surface parallel to it in direction, it will not be able to peck into it, or wound it. When using the crotchet, we should begin with as little force as may be attended with a good effect; since, if not sufficient to bring down the head, it may be easily increased; recollecting that whenever this instrument is using, we must always keep that hand which is within the uterus directly opposite the beak of the instrument, so that in the event of the parts of the child giving way, no accident may happen to the uterus. We should use a force that we can command; and if the pelvis be of sufficient dimensions, bring the body down without removing any more than the head; for when once the head is delivered, the body will soon follow, as it is easily compressed

Where the deformity is very great, and the passage very small, we should begin to open the head very early in labour, puncturing whatever part we first reach, by a hole drilled up to the stops. We should then cease, and trust in some measure to that putrefaction which the moisture and warmth of the parts will be sure to produce instantly. This putrefaction will proceed very rapidly; and the bones, and indeed the whole body, will come away easier, separating from each other with infinitely less force than before they could have done. When the patient cannot be left longer with propriety, after about thirty-six hours, we may proceed to bring away, piece-meal, the various bones of the cranium; the temporal, frontal, occipital, and parietal bones; after which the remaining part of the head will only be the basis of the skull, which admits of being placed in a more favourable position for passing through the pelvis; for the parietes being carefully laid over the bones whenever they may be felt exposed, it will protect the uterus from injury, and then if the remains of the head be brought forward, and doubled down with the chin to the breast, it will, in this state, be frequently capable of being delivered. This sort of labour is very tedious; it lasts a very great length of time; but it requires no skill. We must be aware, that when we have brought the head down, we must not always expect the body to follow, as in other cases, but shall sometimes be obliged to bring away the whole child by pieces. It may be necessary, in order that the body may pass, to take out the heart and lungs, and every organ one after the other. All the caution that need be given is, to take care not to injure the woman in doing what we are about, neither in separating the parts, nor in bringing them away.

On facilitating Labour by turning the Child. It will sometimes happen that, in spite of a slight deformity of the pelvis, we have a chance of saving the lives of both the mother and the child. And there are two modes of attempting to do this; the first is by turning the child, which will also apply to other cases as well as deformity of the pelvis; the second, by bringing on premature labour. Turning is not the best of the two resources; but many women will submit to this, who will not submit to the proposal of bringing on premature labour.

After turning a child, we may pull it through by the feet, while we never should have been able to have delivered it without, for the uterus would not have been able to push it through, in the common way of presenting with the head to the os uteri; and if we prove able to save the child's head, it is a grand point. If after we have brought the feet down, the head will not pass, even then we are only where we were at first, and can open it.

On bringing on Premature Labour. The operation that is certainly the best method of managing delivery, in deformities which admit of it, is premature labour, which is founded upon these positions; that during pregnancy, the head of the child is increasing in size, to the time of delivery; so that if we take them in their gradual increase of size, it is pretty plain that one in the early months of pregnancy would pass with ease through a pelvis that would not receive it at a later period: and in this way, by considering the case in all its parts, comparing the diameter of the pelvis with the size of the head at different periods of the pregnancy, we shall be able to calculate the time when we may bring on premature labour, fixing either the seventh month, seventh and half, or eighth month, but never later; for if we do, the head will be too much ossified to submit to the pressure it must sustain, with that ease which is necessary to the delivery being perfectly safe. It may, indeed, be brought away as early as five or six months, but the child then cannot be expected to live; and if it be produced later than eight months and a half, the labour will be as difficult as that at nine months.

The first step towards bringing on premature labour is, to carry up a male catheter through the vagina to the os uteri, and to introduce it with care, in such a manner as that the point of the catheter shall be in contact with the sides of the uterus, using a gentle pressure only. When the extremity of the catheter is against the membranes, but clear of the child, the instrument is to be thrust forward so as to break the membranes; and in this the catheter is preferable to a rod of silver, since as soon as the catheter enters we know the object for which we introduce it is gained; for while the instrument is still in our hand, we shall feel the waters passing off more or less; while if a solid rod be employed, it may be necessary to introduce it a second time. In puncturing or breaking the membranes, it is also preferable to get the instrument some way up the side of the uterus, instead of breaking them immediately upon the os uteri, because, in the latter way, the child is most frequently born dead, which depends on the different effect with regard to the flowing off of the waters, produced by the mode of puncturing or breaking the membranes.

The breaking the membranes at the side, only allows a partial escape of the waters, quite sufficient to produce a disposition to contract in the uterus, without permitting any injurious effect to arise from pressure; while, on the other hand, when they are broken in the front, the whole of the waters flow away, the uterus contracts very strongly round the child, and the circulation generally suffers, and is either partially or completely interrupted. Delivery, by bringing on the action of the uterus prematurely, is for many reasons very estimable; a month or two before delivery naturally produced, the head is not only smaller, but more compressible; there is a less proportion of bone; so that if we take two heads of the same absolute size, one being of eight months formation, and the other seven, still that at seven would have the advantage in passing through a narrow pelvis. It is difficult for any one to determine the time which should apply to different pelves; but where the distance between the pubes and sacrum is under three, yet all but three inches, eight months may be allowed; where the distance is two and three quarters, seven months, and so on. Yet when a child is born at seven months it will rarely suck, and requires the utmost attention to be reared. By these means, then, we may be able to save two lives; by the Cæsarean section we certainly lose one life, and by doing nothing we lose both.

Preternatural Labour. We now proceed to a consideration of the third class of labours, into which we have divided our subject, and which are generally denominated preternatural, or cross-births; including all presentations but those of the head. This class is naturally, therefore, divisible into presentations of the lower and presentations of the upper extremities; and to this subdivision we shall adhere.

We know little of the cause of preternatural presentation; perhaps it depends on a peculiarity of form either in the uterus or pelvis. It is said to arise from accidents, because there are more instances of it in the lower walks of life; that is very true; and there are more aquiline noses among the poor people than among the rich, and more noses of every kind; because the truth is, there are more individuals in one class than in the other. Preternatural births are most likely the effects of peculiarity of shape in the parts.

Presentation of the lower Extremities. This constitutes our first division of labours of this kind, and is capable of being finished by the powers of nature alone; and the only consequence would be upon the child, to whom such delivery is not always safe; for when the feet present, and the child is gradually expelled, the child in figure forms a cone, which all along increases to the shoulders, and the head is born last of all; the navel-string would be born long before the shoulders were disengaged, the effect of which would be, that the circulation would be interrupted in the cord, and perhaps suspended; for pressing the navel-string before birth is the same as pressing the throat after it; each produces death. After this observation, we have only to remark, that when the cord comes down by the navel passing through, a portion of the cord should be drawn slack after it, that it may not be stretched by the child's passing under the pubes.

When the feet or breech have presented, there is plenty of time to turn the occiput to the pubes, long before the head is down. Whether one foot or the breech presents, it is better to let it come so, than to go up and bring down either one or both feet: because, in breech presentations, the parts are gradually and well dilated, before the cord is likely to be compressed, therefore it is safer; besides, the inferior extremities, in breech cases, lie upon the sides of the abdomen, by which they protect the navel-string lying between the two from any pressure whatever. So that we see all breech cases should be left unturned; and we may ascertain the breech from the head, by feeling the parts of generation, as well as various depressions, without that uniform defined resistance which is given by the head. When the breech presents, the meconium will generally come away by the pressure squeezing it out of the abdomen. Suppose that in a breech presentation any accident happen to the woman needing immediate delivery; it has been said that the forceps may be applied; but from frequent trials we can say that they are of no use; they are not calculated to hold such parts, and always slip off. Another plan recommended is, to get a handkerchief between the thighs and the body: this is an exceeding good purchase, but in the living subject we can scarcely do it; we cannot get it between the legs and body. If neither of these plans succeed, there is only one remaining; this is the carrying up the blunt hook, and so placing it over the thighs; this certainly commands the delivery; and where a small equally applied force is sufficient, it will be both successful and safe: but as it is self-evident that iron must be always stronger than bone, there will be a great risk of breaking the thigh-bones by this instrument. Yet the woman is not to die to save the child's thigh-bone from the risk of being broken; and it is certainly better to have to treat a child with its thigh broke, than one whose brains have been all scooped out. We should, however, be careful never to employ the least unnecessary force.

The feet being born and the breech passed, the part which next presents is the umbilicus; and as the body afterwards passes further down, the cord will be both pressed and dragged; and if a cylindrical yielding cavity be dragged, the cavity of that cylinder is diminished in its calibre, and the tube will ultimately be obliterated; so that the best practice will be, as soon as a part of the umbilicus can be felt, to pass up the finger and bring down sufficient to prevent its stretching in the progress of the expulsion; and as soon as the head is in the pelvis, to bend the face down, bringing it forward upon the breast of the infant, and opposite the os externum, by which means the child will commence breathing; and if the navel-string only pulsate up to that time when breathing commences, the child is safe in all that regards suffocation; and as to the head remaining within the os externum, it is of no consequence whatever. If the child's head cannot be brought through, we must pull, drawing it with caution. Some practitioners will pull the child very hard, which is quite improper; not that it is any material object to the woman, but to the child; the force being applied with the hopes of the child's being born alive; but is it very likely that its life will be saved after a leg or an arm is pulled off, or after the body is pulled so hard as nearly to be separated from the head?

Second division of Preternatural Labour. The other division of this class of labours is that in which the *upper extremities present*. This is now and then an original presentation; but sometimes it is artificial. It may be called original if felt before the membranes be broken, in the absence of a pain. It may be called artificial when the hand being felt by the practitioner, perhaps with some other part, is drawn down through the os uteri and the position of the presentation varied; though it originally was a head presentation, it may be made a shoulder presentation. When the hands are at the os uteri, they are easily distinguished from the feet by the thumb not being in the same line with the fingers; while in the foot we distinguish the toes and heel. The shoulder has been mistaken for the back, and it is a mistake easily made in practice. In distinguishing, we should recollect the superior extremities have the scapulæ behind them, while at the breech we feel the organs of generation. We may here lay down a rule, which is of the greatest consequence, and applies to all kinds of practice in midwifery: that is, that the shoulders and arms will never pass together the labour may continue, but if that presentation be not altered, the woman will be worn out and die. We must return an upper extremity; and never regard it as a matter of choice, but as a rule of practice which must always be adopted. We must turn, because it is a presentation that cannot be delivered. This altering the position of the child, in utero, is called the art of turning, which art, in modern science, is attributed to Ambrose Paree, though it is mentioned as far back as the time of Celsus, who says it is sometimes necessary; he does not, however, say whether it were ever done on a living child. Ambrose Paree's words are, "that in all cases where the upper extremities present, you must turn and bring down the feet; and if the midwife cannot do it herself, she must send for a surgeon who can."

The nature of these presentations may vary so much, that it may be necessary to mention some circumstances. Suppose a case in which the waters are not yet discharged, and the labour is going on very naturally, but by examination through the membranes between the pains, we find that an arm or a shoulder presents, yet we may, perhaps, not know exactly the parts; in such case, we should not be absent from the woman, upon any account, at the time of the membranes breaking, for it will make all the difference in the world as far as relates to that labour. We must ascertain the exact position of the child, and we must then proceed to turning. The question now is, what time in the progress of the labour is most proper for this operation? Bourdelois says, when the membranes are broken, and the os uteri dilated. Dr. Hunter is of the same opinion. Dr. Clarke differs from them both, and justly; for he found, that if we delay turning till the waters have come away, and the os uteri is quite dilated, we allow it to remain to the increasing the difficulty of the operation. If we take it when the os uteri will admit the fingers and knuckles, it is the better time, because we then turn the child as if in a bucket of water; and this gives us so clear an advantage that it needs no explanation. This then is the most convenient period, and we should begin by dilating the os externum, previously intimating our design to the patient, cautioning her not to be in the least frightened at what we are going to say; we may then inform her "that the child does not lie quite right, but it may soon be set right, and with little trouble." It being then agreed upon, the woman is to be laid close to the edge of the bed; and we roll up the sleeve of our shirt and pin it, anoint the hand and fore-arm, and dilate by forming our hand into a cone, first going gradually through the os externum, taking our time, and being very gentle; but we should not pass on dilating beyond the vagina, until our hand passes easily through; if we do, we shall feel the inconvenience of it afterwards, by the contraction of those parts: having got our hand through the vagina, we may let it remain awhile, and should a pain come on, it may waste itself on our hand. We should then gently begin again to dilate till we get our hand into the uterus; when we turn the child gradually round, bringing the head to its proper situation.

There is no difficulty if we once get our hand up through the os uteri, that being dilated sufficiently, without the membranes being broken. But suppose another labour, where the membranes are broken without the os uteri being dilated. We have here much more to do, and less chance for doing it well than we had in the other example: we must go on, and have to turn the child too, under the increased difficulty of the contraction of the uterus, which will not, indeed, be violent, but quite enough to render the turning difficult. But if we be able to manage the most easy case, and the most difficult, we should be equal to all the subordinate or intermediate degrees of difficulty that may be met with in turning.

To give an example of the greatest degree of difficulty, suppose a case where the waters have been lost twenty-four hours, two days, or even three. What we have to do in overcoming the contraction of the uterus, is not altogether a matter of difficulty as to skill, so much as it is as to time and management. With a view to lessen the difficulty, opium has been given: but great caution is required in its exhibition; since a woman has been known to die from the use of opiates; she has been drained to death by uterine hæmorrhages.

The last circumstance necessary to notice with regard to preternatural labour is, that all the other parts being brought down, the head sometimes cannot be got through well. We may here use a moderate force, by pulling with the body, remembering that our object in using force is to save the life of the child. Besides, why should we use a force too great when we may always deliver with the forceps? Though where violence is unavoidable, it is best to open the head.

To employ that force which, without violence, may assist in bringing away the head, a good method is to make a sort of loop, by bringing a handkerchief loosely round the neck; when letting the ends down upon the breast, we tie them rather low on the breast, so that there may be plenty of room to place our hand within it to pull by, and if we succeed we must mind, that in bringing down the head, we depress the sides of the head so as to bring it into the hollow of the sacrum. If it will not come by any means, we must then open it: when we have extracted the brain we should introduce the blunt hook, and it is used with the most effect when seconded by the pulling of the body,

In some instances it happens that the head is entirely separated from the body, when various means have been recommended for bringing it away. The only sure method, however, is to open it; and when we have dilated it by expanding the perforator, we should introduce the crotchet before we withdraw the perforator, in order to have the head always secure, from slipping, as it otherwise would do. The difficulty is, that whenever we touch it we have a smooth slippery surface, which we cannot keep unless we have an instrument within the hole we have made. It will roll over the upper aperture of the pelvis. We must recollect always to keep one hand in the vagina, while any operation is going on, for the extraction of any body which may be within the uterus, and in order to guard the instruments.

DISORDERS SUBSEQUENT TO DELIVERY.

Most of the diseases consequent upon pregnancy arise after delivery, and not during labour. We shall first observe, that

Quietude and a horizontal position should be strictly enjoined, as a matter of the greatest moment. And for this reason it is obvious, that as the patient should not be moved early, she ought never to be delivered in her clothes. This, however, is a plan often proposed by the lower orders of people to save inconvenience and expense; but it should never be assented to by the practitioner, as it is a very dangerous experiment to raise the patient to an erect posture, at a time when she can only remain perfectly safe in an horizontal position. There are many instances of the fatal effects of neglecting such a precaution.

A woman after delivery should remain perfectly at rest for at least two hours, and then should by no means be raised upright, but be very gently lifted, just enough to allow the drawing away of the clothes, which, if they give trouble, must be cut away with scissars, to prevent the risk of exhausting the patient by over exertion.

Fainting. Fainting after delivery frequently happens, and may arise from many causes, most of which are of little consequence: it is always an unpleasant occurrence, and sometimes dangerous. It may be merely the effect of fatigue; a woman is just able to bring the child into the world, and after making perhaps the last exertion she is capable of, sinks into a faint. Frequently she will fall into an hysterical paroxysm, which will easily be perceived, by her laughing, crying, sobbing, &c. which characterizes hysteria. If the fainting proceed from either of the above causes, volatile alkali rouses the patient, and nothing more is necessary; neither should any apprehension be felt for her safety.

Fainting may be the consequence of the great agitation of mind which the patient has suffered from fear of the approaching pains, and, as she thinks, dangers. In such cases nourishing things should be administered, as a small quantity of good broth, with a table spoonful of wine in it; or some volatile alkali.

Whenever there is reason to suspect that the fainting arises from loss of blood, the practitioner should never leave it to probability, but instantly examine the truth of his suspicions, not only on the surface lying next to him, but the upper part of the further thigh, as the blood will sometimes run over the side of the thigh that is furthest off; when the practitioner, not perceiving any discharge from that part whence it is generally observed to flow, has not the least idea of his patient's situation. When upon examination it is found that hæmorrhage has taken place, the placenta being got away, it is to be treated in the common way by acids, &c.

In some rare instances it has happened, that immediately after delivery the patient has sunk into a permanent syncope, from which she never has recovered, dying without a groan. When there is reason to suspect the approach of such a state, the patient should be made to swallow a large dose of volatile alkali; it can do no harm, and is generally highly beneficial, let the fainting originate from whatever cause. The spiritus ammoniæ comp. and tinct. lavendulæ may also be administered, and hartshorn drops should always be kept in a lying-in room.

After delivery it is advisable to apply a certain degree of pressure to the parts. This circumstance has been variously received, and very generally misunderstood. A certain degree of pressure is useful; but if that pressure be too great, it will occasion worse consequences than the want of pressure altogether. The pressure required is, more properly speaking, a support, and is of the same kind as we like to feel from a waistcoat in winter. The intention to be had in view in making it, is just the same as after tapping in dropsy; and pressure judiciously applied in both cases will often prevent fainting.

Suppression of Urine. In the country it often happens, that the practitioner does not see his patient any more after leaving her safely delivered. In such cases, it will be necessary for him to leave general directions with the attendants; the most material of which is, that the nurse shall send for him, if, upon trying, the patient finds herself unable to make water, at the distance of eighteen or twenty hours after delivery. If the patient be neglected, the bladder swells to an enormous size, and at last bursts, in which case death is inevitable.

When the practitioner has been sent for, he must not be satisfied with the patient's telling him that she has since made water, and that a little escapes frequently; all this amounts to nothing, and must not excuse a moment's delay in the introduction of the catheter. It will generally be necessary to draw off the water once or twice a day; but from distance of residence this will sometimes be impossible. In such a case it is not very difficult to teach the nurse how to perform this operation, by shewing her the parts, and pointing out the little orifice, at the same time telling her, the instrument must be passed up carefully and slowly till the water flows from the other end of the tube.

Effusion of Blood into the Cellular Membrane of the Labia Pudendi. This is an accident which now and then happens after delivery. It is merely a mechanical effect of pressure, and very rarely occurs. In one case where the parts had been previously much strained, the swelling was first observed by the patient's finding herself unable to close her thighs together. This blood, if left to itself, will first coagulate round the orifice of the bleeding vessel, and afterwards the whole quantity of effused blood becomes fixed.—There are two ways by which the parts may get rid of this blood, if its quantity be considerable; either by the skin sloughing off, by which part of the blood may escape, or by the part inflaming and suppurating. When the latter circumstance happens, and it is determined to open it, the orifice made cannot be too small, so that the matter be allowed to escape: for the constitutional weakness at such a time as this will give a tendency to gangrene in any part which is divided. Cold is the only application that is to be at all regarded. It has been recommended to cut and scarify the part; but this is objectionable, because, should the artery continue to bleed after the openings are made, the situation of the patient at once becomes serious, for we must necessarily be perfectly ignorant where the ruptured vessel is, and consequently as perfectly unable to stop it. Should it ulcerate, the treatment should be the same as that of an ulcer in any other part of the body.

Lochial Discharge. By this is meant that discharge which follows the expulsion of the placenta, continues for several days, and diminishes in proportion as the uterus contracts. A short time after delivery the vessels which before poured out red blood, will, from the womb having contracted to a certain degree, only ooze forth serum. When small pieces of the maternal part of the placenta remain, with fragments of the membranes, &c. and mix with the lochial discharge, they constitute what the nurses call the green water; and these discharges generally subside in six or eight days, more or less. They will, however, often be reproduced by very slight causes; such as sitting upright, endeavouring to walk, eating stimulating food, or indeed any thing which may increase the action of the heart and arteries. In a strong woman of tense fibres the discharge will be of shorter duration than in a weak woman of lax fibres; if a woman be quiet it will not continue so long as if she be restless. Where the quantity is profuse, and it flows for too long a period, the constitution becomes weakened, and it is necessary to give bark, with the vitriolic acid, or the conserve of roses.

Lacerated Perinæum. The intermediate part of the body, situated between the vagina and rectum, is called perinæum; and from its peculiar situation is very liable to accident from the violence of pressure in labour; this will sometimes happen with the most careful practitioner; it will now and then give way in a trifling degree, and is in such cases of no further consequence, than from its leaving the parts a little sore and weak for a few days. The only laceration of consequence is that from before backwards to the rectum, by which the os externum and rectum are laid into one, and the sphincter ani consequently torn asunder. This accident is, however, extremely rare, and may always be prevented by supporting that part of the perinæum with the hand.

In case of an actual laceration of the perinæum, the first step is to empty the bowels by a brisk purge; after the medicine has operated, the parts should be perfectly cleansed from all fæculent matter, and then the thighs should be bandaged together, by which there is a probability of the parts uniting by the first intention, and in some cases this has succeeded. Should this fail, the only chance is, not to allow the parts to heal except by uniting with each other. If considerable inflammation takes place, it must be reduced by the use of fomentations and cataplasms, and of cooling laxative medicines, and if the pain be violent, opiates may be given. When suppuration occurs, bark must be administered. The dressings may be superficial.

After Pains. Every woman who has been in labour is subject to what are called after-pains, though they do not always occur equally. They come on at regular intervals, and are more or less violent. These pains are very rarely felt after a first lying-in; and they are less when the labour has been retarded, allowing the uterus to contract gradually behind the body of the child, than where the expulsion of the child has been hastened, the uterus then contracting suddenly, but not perfectly. In consequence of these pains, and the fatigue which the woman has sustained throughout the labour, it is a very general and excellent practice to give an opiate of from twenty to thirty drops of laudanum, and afterwards to repeat it in such a diminished quantity as shall allay the irritation, but not the contraction of the uterus.

An after-pain will perhaps come on an hour after delivery, by which a large coagulum may be expelled; and after that others, by which smaller coagula will be separated; and then an after-pain as violent as any of the rest, to throw off one of the smallest possible size. To some women these are very distressing, and are borne with less patience than the labour-pains, as the latter they know are for a good purpose, while the pains after delivery afford no such consolation, and yet are sometimes as violent as the worst pains of labour can be. These pains may be moderated by warm applications to the abdomen, and by small doses of laudanum.

General Treatment of a Woman after Delivery. Practitioners formerly had various ways of treating a woman after delivery. Of these the principal were the high or stimulating mode of treatment; and the low or starving system.

The best practice is to avoid both of these extremes, and to treat the woman entirely according to her situation; if strong and healthy, she may be kept for a few days upon gruel, barley-water, and toast and water; and then, if she be perfectly free from fever, she may eat a little animal food. But if of a weakly constitution, she may have animal food the first day; in the former case no wine should be allowed, in the latter both wine and whatever else will nourish her should be administered. In general no meat should be allowed for the first three days; bread-pudding may be permitted, but if there be the least tendency to inflammation or fever, nothing further. With regard to medicine, much will depend upon the circumstances of the patient; the great object is to keep her quiet; and if this cannot be done without medicine, medicine must be given. A saline draught, either with or without spermaceti, will generally be sufficient; and at night a small dose of the sp. æther. vitr. co. which may be increased if the patient's nights be restless. It is of high importance, however, to give a purge on the third day. It is of little consequence what purgative is used, as long as an evacuation is produced. For many weeks before delivery the bowels of a woman are never emptied of their solid contents; and the quantity that thus accumulates is sometimes very astonishing. Should the purge not operate, an enema should be exhibited the same evening; after which not a day should be allowed to pass without a stool being procured, and this strict attention should continue for the first fortnight.

Milk Fever rarely or never happens where proper care has been taken to preserve a regularity of action in the intestines. Where the bowels are neglected, and there is a disposition to inflammatory fever, the milk being formed in considerable quantity, will greatly increase that tendency to fever.

Sore Nipples. This is a complaint often met with, and very troublesome, and most probably arises from an artificial mode of living. Many women use considerable pressure upon their breasts, and under such circumstances it is natural to expect that the nipples being pressed in, may be absorbed altogether; or if this do not take place, they will give way upon the child sucking, and become sore and painful. If this have occurred in a previous lying-in, the parts may be strengthened by applying to them astringent remedies two or three months before labour. When, however, soreness of the nipple has taken place, the best way to protect it is to use an artificial teat, by which the child can suck equally well, and the nipple itself being undisturbed, will soon heal. The way in which one of these instruments is prepared, is to procure a fresh teat from a heifer, and scooping out the inside, to steep the skin in spirits for an adequate length of time, and then fasten it on the glass instrument: glass is preferable, because by seeing the milk we may be assured that the child is properly nourished. A woman is capable of giving milk with a flat or even a concave surface, by drawing it out with a glass tube that has a small ball to it, by which a vacuum is produced: when immediately as the glass is removed, the child being put to the breast will keep it out by sucking till satisfied.

Where the nipple is sore, it will either be from superficial ulcers, or cracks in the skin, either of which gives excessive pain and distress; and it often happens that after all manner of things have been ineffectually applied, the nipple will heal of itself. Wine, alum solution, and all similar applications, give very great pain, though they seem to be the most beneficial remedies of any that are in use. Indeed it is extremely difficult to know what will answer best; if emollients be applied, less pain will be the immediate effect; but they make the parts more tender, which, when the child sucks, will frequently bleed; and this is unpleasant for several reasons. The child probably swallows the blood, and perhaps, on being sick, vomits it up again, to the great terror of the nurse, the mother, and all around them. If the sore be superficial, it will be much aggravated by sticking to the woman's clothes: in this case, a little cup made of wax is a good protection. The limpet shell will answer the same purpose, the edge being covered with sealing wax; or a walnut shell may do equally well. A fresh ivy leaf laid on after every suckling is very useful, the fine glaze will prevent it sticking, and as it preserves the parts from the clothes it is very pleasant. A careless woman, who does not attend to these apparent trifles, will frequently have the newly formed skin torn off from her nipple, by its fastening to the covering of the breast. No plan however answers so well in all sore breasts as the false teat, as an application will then heal the nipple, or as it will heal without any.

Swelled Legs of Lying-in Women. This is the last disease we shall notice. It never arises before the third day, and rarely after three weeks from delivery. This disease occurs in women that have had hard labours, or easy labours; in strong constitutions, and in weak constitutions; where there is milk in abundance, and where there is none at all; whether the lochial discharge be great or little; and whether the patient be fed high or fed low. So that there seems to be nothing either in the nature or constitution of the woman, which either causes or prevents it; neither would it appear to be affected by the labour, as it seems to rise alike under all circumstances. It is said to depend upon a translation of the lochial discharge, but this is very absurd.

It commonly begins with shivering, the swelling being perceived either general or partial in the leg; sometimes arising over the whole limb at once, and sometimes beginning in the ham. It seems to have some connexion with the absorbent glands, as it frequently commences in the groin, from which part the swelling will continue to extend, till the whole leg and thigh are as large as the body: in this way the leg will be distended to the greatest possible degree, without any redness or inflammation; but it will not bear moving; if the patient be desired to move the limb, it gives her great pain. Swellings in general will pit, but this does not; and it usually occupies one side only; this is observed by Dr. White, who states that even the labium of one side shall be tumid, while the other is quite unaffected.

The swelling too is of a peculiar character; if the hand be drawn across the limb, it does not give the uniform sensation which is commonly felt in swellings, but resembles an infinite number of irregularities, difficult to be described. The best idea that can be given of it is to suppose a block, in shape resembling a leg, covered with brass nails of various sizes, and these covered with skin stretched over it. The disease is acute, and the symptoms of fever will sometimes be considerable, and then it is by no means surprising that the secretion of milk is lessened, or the lochial discharge diminished, for the reason that the circulation is determined to other parts. In ten or twelve days the hardness of the swelling ceases, and the state of the disease is changed to a true œdema, and the limb remains weak for several months. Such a limb will always be more affected by cold than the other; after any exercise, as dancing, it will be more stiff and weak the next morning than the other. This disease sometimes attacks both sides in succession; it never occasions suppuration. Dr. White indeed mentions one instance of this effect; but it is doubtful, from his description, whether it was this sort of swelling, for œdema sometimes resembles it very closely

It is difficult to determine the cause of this alteration of parts, or change of organization. Dr. White attempted to explain it, by supposing that an absorbent vessel gives way at its entrance into the gland, and that the lymph, still passing upwards, overflows, and enters into the cavities of the cellular membrane, and there coagulating, gives the unequal feel observed. This, however, is by no means a satisfactory explanation of the nature of the disease. It is difficult to know how we are to proceed in the cure of a disease with which we are so little acquainted. It is certainly useful to keep the bowels open, and to promote a gentle but continued perspiration. For this purpose antimonials and the saline draught will be efficacious; and when the pain is excessive, opium should be given: if the fever be considerable, abstinence from animal food will be necessary. As to the limb itself, nothing gives more ease than laying it in a soft poultice, which will also have the good effect of keeping up a gentle perspiration; it forms the softest pillow that can be imagined, and never fails to bring relief.

Treatment of Infants. It is usual in tracts upon midwifery to enter upon this subject in detail; but having already enlarged upon it under the article INFANCY, we refer our reader to what we have there advanced, which we trust will be perfectly satisfactory.

MIEGIA, in botany, a genus of the Triandria Monogynia class and order. Essential character: calyx one-flowered; corolla two-valved; nectary one-valved, involving the germ; seed triquetrous rounded, included within the calyx, corolla, and nectary. There is but one species; *viz.* M. maritima, a native of the sandy coasts of Cayenne and Guiana.

MILE, *mille passus*, a measure of length or distance, containing eight furlongs, &c. See MEASURE.

The English statute mile is fourscore chains, or 1760 yards; that is, 5280 feet. See CHAIN, YARD, and FOOT.

We shall here give a table of the miles in use among the principal nations of Europe, in geometrical paces, 60,000 of which make a degree of the equator.

	Geometrical paces.		Yards.
Mile of Russia	750	or	1100
of Italy	1000	or	1467
of England	1250	or	1760
of Scotland and Ireland	1500	or	2200
The small league	2000	or	2933
The mean league	2500	or	3666
The great league of France	3000	or	4400
Mile of Poland	3000	or	4400
of Spain	3248	or	5028
of Germany	4000	or	5866
of Sweden	5000	or	7233
of Denmark	5000	or	7233
of Hungary	6000	or	8800

MILIUM, in botany, *millet grass*, a genus of the Triandria Digynia class and order. Natural order of Gramina, Graminæ, or Grasses. Essential character: calyx two-valved, one-flowered; valves almost equal; corolla very short; stigmas pencil-form. There are twelve species, of which M. effusum, common millet grass, has a perennial creeping root; slender culms, three or four feet high; leaves from four to seven inches or a foot in length, thin and weak, very finely striated their whole length; panicles from four inches to a foot in length, nearly upright, spreading and loose: it appears to be much scattered, from the various lengths of the pedicles, which grow in whorls. This plant is distinguished from the panics, to which it has the greatest affinity, by having a calyx of two valves only. Native of most parts of Europe, in woods.

MILK, the fluid designed for the nourishment of young animals, and which is secreted in particular organs by the females of the class Mammalia, is a white opaque fluid, having a sweetish taste, and a specific gravity somewhat greater than that of water. When milk newly taken from the animal is allowed to remain at rest, it separates into two parts; a thick white fluid, called cream, collects on the surface, and the fluid beneath is more watery. The quantity of cream obtained from milk, and the time it requires to separate, vary according to the nature of the milk, and the temperature of the atmosphere. When the milk is allowed to stand after the spontaneous separation of the cream, it suffers another change: it first becomes acescent, and then coagulates. When the coagulum is pressed gently, a serous fluid is forced out, and the remainder is the caseous part of milk, or pure cheese. Butter and cheese are obtained artificially; the former by the operation of churning, and the milk which remains after the butter has been separated, or, as it is called, the butter-milk, has all the properties of milk from which the cream has been separated. Cheese is obtained by the addition of rennet to the milk, which is prepared by digesting the inner coat of the stomach of young animals, especially that of the calf. The quality of the cheese depends upon the quantity of cream that remains in the milk. The best cheese is obtained by coagulating the milk at the temperature of 100°, and expressing the whey slowly and gradually, without breaking down the curd. Whey expressed from coagulated milk, if boiled, and the whole curd precipitated, becomes transparent and colourless. By slow evaporation it deposits crystals of sugar, with some muriate of potash, muriate of soda, and phosphate of lime. The liquid which remains after the separation of the salts is converted, by cooling, into a gelatinous substance. If whey be kept, it becomes sour, by the formation of an acid, which is the lactic acid; and it is to this that the spontaneous coagulation of milk after it remains at rest is owing. Milk may, after it is sour, be fermented, and it will yield a vinous intoxicating liquor. This is practised by the Tartars on the milk of the mare. Milk is likewise susceptible of the acetous fermentation. The results of very minute experiments prove that the constituent parts which enter into the composition of milk, are

Milk
Oil
Curd
Gelatine
Sugar of milk
Muriate of soda
Muriate of potash
Phosphate of lime
Sulphur.

The milk of different animals is found to be composed of nearly the same substances; but the proportions vary so much, as to give them very different properties. We shall give a brief account of the analysis of the French chemists Deyeux and Parmentier.

1. Every kind of milk, when left at rest, produces cream on the surface; but it is different in the milk of different animals. In that of the cow it is copious, thick and yellow. In women's milk the quantity is small, and it is white and more liquid. Goat's milk produces abundance, and it is thicker and whiter than that from the cow. Ewe's milk produces as much as that of the cow, and of nearly the same colour. The cream from asses' milk resembles women's. In mare's milk it is very fluid, and similar in colour and consistence to good cow's milk before the cream appears on the surface.

2. Butter obtained from the milk of different animals is thus composed. That of the cow differs in colour; but has always much consistency. That from women's milk is small in quantity, insipid, and of a pale yellow. The butter of asses' milk is always white, soft, and disposed to be rancid. That from goat's milk is abundant, white, and soft. The butter from ewe's milk is yellow and soft: that from mare's has but little consistence, and is readily decomposed.

3. The caseous part of milk varies in different animals. That from the milk of the cow is bulky, and retains much serum. That from women's milk is small in quantity, has an unctuous feel, and but a small portion of whey. The curd of asses' milk is similar to that of the women's, but not unctuous. Curd from the milk of the goat is abundant, of a firmer consistence than that of the cow, and retains less whey. Curd from ewe's milk is fat and viscid: that from mare's milk is very similar to what is obtained from women's milk.

4. The serum, or whey, constitutes a great proportion of the milk, and shews the following varieties. That from the milk of the cow has a greenish cast, a sweet taste, contains sugar of milk and neutral salts. The whey from women's milk has little colour; but contains much saccharine matter. The whey of asses' milk is colourless, and contains less salts, and more sugar than that of the cow. Whey of the goat is yellowish, and contains very little sugar and saline matter. The latter is muriate of lime. The whey of ewe's milk is always colourless, and contains the smallest quantity of sugar, and but a small portion of muriate and phosphate [illegible] lime. That of mare's milk has little colour, and contains a large proportion of saccharine matter, and of saline substances.

MILL, is a machine, which, by means of any adequate force, as steam, water, wind, or animal exertion, acquires such an additional power as enables the machinery to act with increased effect, and with the requisite regularity. It may be considered an axiom, from which very few, if any, deviations are to be found, that the nearer the labouring part is to the power or origin of motion, the greater will be the force employed; but that force will be subject to such fluctuations, and to such shocks and vibrations, as to render the work inaccurate and unequal. In some operations this is of less importance than in such as are connected with minute and delicate manufactures. Thus, in brass, copper, and fulling-mills, the large hammers which perform the heavy work derive their motion immediately from the great wheel which is turned by the stream; they being lifted by cogs, or teeth, set on its axis, and working without any intermediate machinery. In saw-mills, the blades which cut the timbers into planks, &c. are removed from the great wheel by the intervention of other wheels, which not only give increased velocity, but relieve the saws from those jerks and strains to which they would be subject, if deprived of those movements which render their own operations equable and firm. In corn-mills the velocity is again increased by another course added to the system, while the action of the grinding parts is thus effectually discharged from all inequalities of motion; and thus flour, &c. may be ground with certainty to any desired degree of fineness, according as the distances between the stones may be regulated. With regard to the more complex movements required in the manufacture of silk, cotton, &c., many of them are so remotely connected with the moving power, that they may be made to revolve with the most wonderful exactness. It is, however, necessary, that the frame work of a mill should be very firm and substantial; that the pinions, spindles, and axles, all move freely in their sockets, which should be exactly at right angles with them; and that no greater pressure should take place on any part than the duty it is to perform may render necessary. These great principles are inseparable from the proper construction of mills. We consider a knowledge of the powers of mechanism to be absolutely indispensable towards a due understanding of this subject, and recommend the student to refer to the head of MECHANICS, for such information as may enable him to form a more correct judgment of the particulars relating to mill-work in general.

With respect to machinery moved by steam, we need say little in this place, since the movements dependent on that kind of power may be found under that article, while the remote or subordinate parts will be seen in the construction of such mills as derive their action from wind or water. The selection of the power is not always within our choice; but must depend on the abundance of fuel, the supply of water, and the due elevation of the spot where the mill is to be erected. Where coals are cheap, the steam engine, being so immensely forcible, and capable of any desirable bulk, is in most instances preferred. Where fuel is dear, and that a stream of adequate size can be applied, water becomes the momentum; but where neither of the foregoing can be found under suitable circumstances, a well exposed spot is ordinarily selected for the erection of a windmill. We shall shew the quantity of water necessary to work a wheel of certain diameters; observing that eighteen feet has been found from experience to be the most commodious measurement, as well as sufficiently powerful for any overshot-mill; indeed for breast-mills, that diameter may be considered as capable of giving motion to all the ordinary systems of machinery. It should be observed, that the breadth of the water-wheel ought to correspond with the power necessary on the occasion, supposing that a proportionate volume of water is at command; for a wheel of two feet in breadth will be more than doubly as powerful as one of only a foot in breadth; there being a double volume of water acting upon it, while the friction of the axis is by no means doubled by the added breadth.

Water is generally made to act upon machines, particularly water-wheels, by means of its momentum when in motion. We have already shewn, under the heads of HYDRAULICS and HYDROSTATICS, how water derives force from its depth, or gravity. The effect of water in motion will depend manifestly upon the quantity of fluid and its velocity jointly. Desaguliers, in his Experimental Philosophy, vol. ii. p. 419, gives the following easy mode of ascertaining these data. "Observe a place where the banks of the river are steep, and nearly parallel, so as to make a kind of trough for the water to run through; then by taking the depth in various parts of the stream's breadth, obtain a correct section of the river. Stretch one line over it at right angles, and another at a small distance above or below, but perfectly parallel. Now throw in some buoyant body (such as an apple, which will not float so high as to be affected by the wind) immediately above the upper line: observe the time it occupies in passing from one to the other string. Thus you ascertain how many feet the current runs in a second, or in a minute. Then having the two sections, *i. e.* one at each line, reduce them to a mean depth, and compute the area of the mean section, which, being multiplied by the distance between the lines, will give the solid contents of the intermediate volume of fluid, which in the noted time passed from one string to the other. Now this way, by the rule of three, is adapted to any portion of time; the question being merely if the velocity be such in such an area, or trough, what would be the velocity in another of less size. It is obvious that if the area give twelve solid feet, and that water passed at the rate of four feet in a second, through a conduit of one foot square; if the conduit were only six inches square, the velocity would be as 16 to 4; or, in other words, quadrupled. The arch of a bridge is an excellent station for observing the force of a stream; because the sides are there regular, and the intermediate space may be correctly ascertained. But the depth is not always to be ascertained in such places without the aid of a boat, or of two intelligent assistants, who should be very correct in their observations."

The late Mr. John Smeaton made a variety of experiments on the powers, velocities, and friction, attendant upon water wheels of various sizes, and under different influences. He observed, that, in regard to power, it is most accurately measured by the raising of a weight to any given height in a given time: according to the weight raised, the height, and the time, so is the product to the power by which it is effected. For a power that can raise ten pounds to the height of ten feet in one second will correspond with that power, which, in the same period, can raise five pounds to twenty feet in height; it being evident that the products must be the same. But in such case the power is supposed to be equable, without the least acceleration or diminution of velocity: and even then we are rather to consider this as a popular and simple mode of estimation: for the quantity of motion extinguished, or produced, and not the product of the weight and height, is the true, unequivocal, and perfect measure of the mechanical power really expended, or the mechanical effect actually produced: these two are always equal and opposite. Yet it is true that Mr. Smeaton's mode is most applicable to the cases in which he adopts it.

To compute the effects of water-wheels with precision, it is necessary to ascertain, 1. The real velocity of the water which impinges or acts upon the wheel; 2. the quantity of water expended in a given time, and, 3, how much of the power is counterbalanced, or lost, by the friction of the machinery. Mr. Smeaton established, after a variety of experiments, that the mean power of a volume of water, 15 inches in height, gave 8.96 feet of velocity in each minute to a wheel on which it impinged. The computation of the power to produce such an effect, allowing the head of water to be 105.8 inches, gave 264.7 pounds of water descending in one minute through the space of fifteen inches; therefore, 264.7, multiplied by 15, was equal to 3.970. But as that power is found equal to raising no more than 9.375 pounds to the height of 135 inches, it was manifest that a major part of the power was lost; for the multiplication of these two sums amounted to no more than 1.266; of course the friction was equal to ⅔ths of the power.

Mr. Smeaton considers the above to be the maximum single effect of water upon an undershot wheel, where the fall is fifteen inches. The remainder of power, it is plain, must be equal to that of the velocity of the wheel itself, multiplied into the weight of the water, which, in this case, brings the true proportion between the power and the effect to be as 3.849 to 1.266; or as 11 to 4.

Where a wheel revolved 86 times in a minute, the velocity of the water must have been equal to 86 circumferences of the wheel; which, according to the dimensions of the apparatus used by Mr. Smeaton, was as 86 to 30, or as 20 to 7. The greatest load with which the wheel would move was 9*lb.* 6*oz*; by 12*lb.* it was entirely stopt. From this we are to conclude, as Mr. Smeaton did, that the impulse of the water is more than double what our theory states it to be. This he accounts for by the wheel being placed in a narrow slit; so that the water could not escape but by passing with the wheel's motion; thus giving a multiplied force. Further, it is to be remarked, that when a float-board comes in contact with the water, it receives a certain check, which causes the back or upper part of the float-board to become loaded with a kind of wane, which accumulates in consequence of the momentary impediment, and consequently adds to the impetus. This added force must ever be in proportion to the depth to which the float-board sinks into the stream; not exceeding its whole depth beyond the rim, or body, of the wheel to which it is attached.

The following conclusions result from the velocities of wheels, as acted upon by different heights of water. 1. The head, or altitude, being the same, the effect will be proportioned to the quantity of water expended; or, in other words, according to the weight and velocity of the impinging fluid. The expence or quantity of water being the same, the effect will be nearly in proportion to the height of the head. 3. The quantity of water expended being the same, the effect is nearly as the square of the velocity. 4. The aperture whence the fluid issues being the same, the effect will be nearly as the cube of the velocity. Hence, if water passes out of an aperture in the same section, but with different velocities, the expence will be proportioned to the velocity; therefore, if the expence be not proportioned to the velocity, the section of the water cannot be the same. 5. The virtual head, or that from which we calculate the power, bears no proportion to the head-water; but when the aperture is larger, or the velocity of the water less, they approach nearer to a coincidence; consequently, in the large openings of mills and sluices, where great quantities of water are discharged from moderate areas, the head of water, and the virtual head (determined from the velocity) will nearly agree, as experience proves. 6. The most general proportion between the power and the effect was 10 to 3; the extremes are 10 to 3, 2, down to 10, 2.8. 7. The proportion of velocity between the water and the wheel is usually as 5 to 2. 8. Although we have no certain maximum of the power of a wheel, that is, what it will carry, and no more, we may generally consider the limits to be, that wheels which work freely with 15 will stop, when 20 are opposed to their motion: consequently, when 3 is the effect, 4 will stop the work. But in general we find it extremely difficult to ascertain this point; though in works that are perfectly well executed, and where the powers, with the resistances, are judiciously computed, the quantity of the latter necessary to produce equilibrium, which here amounts to cessation, will be found to correspond with that scale.

Speaking of float-boards, it may be proper to state, that they should be rather numerous than few. Mr. Smeaton found, that in undershot mills, when he reduced the number of floats from twenty-four to twelve, the effect was reduced one half, because the water escaped between the floats without touching them; but when he added a circular sweep of such length, that before one float-board quitted it another had entered it, he found the former effect nearly restored.

This mode more particularly applies to breast-wheels, or such as receive the water immediately below the level of the axis. In such the circular trough is indispensable; because the water would not communicate the full effect desirable from the joint operations of velocity and weight. In this kind of wheels it is proper that the float-boards should be confined, both at their sides and at their extremities, so that the water may accompany all the way from the head down to the lowest part of the wheel, whence it should draw off with sufficient readiness to allow the succeeding fall to supply its place, without being in the least retarded. It should be understood, that any quantity of water remaining in the trough, at the bottom of a breast-wheel in particular, must tend more or less to oppose its motion, in the exact ratio with the disposition of the fluid to become stagnate or stationary.

The overshot wheel is by far the most powerful; both because it receives the water at the very commencement of descent, and that the buckets with which this kind of wheel is ordinarily furnished retain the power until they gradually discharge their contents, as these buckets successively become inferior parts of the circumference. It should be stated in this place, that much may be effected by allowing the water merely to flow upon the upper part of the wheel into the superior buckets, whereby an immense auxiliary power is erected as they successively become filled. Add to this the discovery made by Mr. Smeaton, that "the more slowly any body descends by the force of gravity, while acting upon any piece of machinery, the more of that force will be spent upon it, and consequently the effect will be the greater." That effect is by no means increased in proportion to the velocity of the wheel's motion; on the contrary, Mr. Smeaton found, that when his wheel, which was two feet in diameter, revolved 20 times in a minute, its effect was greatest: when it made only 18½ turns the effect was irregular; and when so laden as not to make 18 turns, the wheel was overpowered by the load. He found that 30 turns in the minute occasioned a loss of about $\frac{1}{10}$, and that when turned 30 times in a minute, the diminution of effect was nearly one fourth of its powers. This proportion may be easily estimated on any wheel of greater extent, by computing the proportion of accumulated power lost by greater velocity, than may be sufficient to load the wheels by means of the buckets being filled; observing that the progress of a machine may be so much retarded as to cause the effect to be irrelevant of the purpose, although the machine may be kept in motion. Some machines do their work well, simply in consequence of a certain celerity, as is generally the case in a grinding apparatus: thus also every person conversant in the practice of agriculture is sensible, that when a plough is drawn at a certain pace, it will cut the soil regularly and freely, while, on the other hand, the same cattle proceeding at a very slow pace shall be more fatigued with doing less work, and that work by no means so neatly executed. All things considered, it will perhaps be found, that the great wheels of all machines ought to move at such a rate, as to cause their circumferences to pass over three feet in each second of time. We could instance several very large wheels, erected within the last five or six years, which scarcely make more than one revolution in the minute, but which operate so forcibly on the counter-wheels, as to give an astonishing degree of firmness as well as of regularity to their motions.

The maximum load for an overshot wheel is that which reduces the circumference of the wheel to its proper velocity, which is known by dividing the effect it ought to produce in a given time by the space intended to be described by the circumference of the wheel in the same time. The quotient will be the resistance overcome at the circumference of the wheel; it is equal to the load required, including the friction and the resistance of the machinery. So much, however, depends on the proper precautions for reducing the friction of the several moving parts, that too much stress cannot be laid on that highly important consideration. We therefore solicit those readers, who may wish to render themselves conversant in this branch of science, and especially if practical knowledge is in view, to refer to the article Friction, where they will find many very necessary points treated of, with as much attention to their interests as our limits could allow.

We may, in theory, suppose a wheel to be capable of overcoming any resistance whatever; yet we always find, in practice, that the wheel stops, or at least is incapable of progressive motion, when the opposition or load is equal to the sum of the water contained in all the buckets. In this we speak of overshot wheels, which designation includes all that carry the water with them in their descent, and do not depend so much on its velocity as its weight: hence many kinds of breast wheels, which are constructed according to the above plan, are by many persons classed with overshots; the latter, however, strictly speaking, applies solely to such as receive their impulse somewhere above their centres; generally indeed at their summits. The breast-wheel, when well constructed, may carry an effect equal to half, or even to three-fifths, of the power; while the overshot wheel ordinarily works with a result equal to four-fifths of the momentum: but Mr. Smeaton thinks the generality (owing to a want of exact levels, and of a due fitting and squaring of the parts, together with an inattention to the removal of friction,) do not perform work beyond half the power. Many attempt too great velocity, which, as already shown, produces considerable diminution of power. Mons. Parent, whose principles were considered by Desaguliers and Maclaurin to be perfectly correct, considered that the wheel should move with about $\frac{3}{8}$ths the velocity of the water, the ratio combining the essential points of receiving the full force of the stream, and enabling the engineer to regulate the interior or dependent parts in such a manner as might answer their intended purposes, and give perfect effect to the whole. As to the velocity of the stream, that cannot always be made to equal our wishes, on account of the scanty supplies in the many instances, where greater falls, or more impetuous force would prove highly valuable. It is, however, generally in our power to diminish the velocity by means of sluices, overflows, &c. so as to carry off any redundancy, and to limit the power within the bounds of safety and utility. But we trust it has already been partially shown, that, by confining a stream within more narrow bounds than its natural banks may afford, the velocity may be considerably increased; and we presume it must have been already understood, that by giving additional height to the fall, or head, whence the water flows upon the wheel, velocity, or at least power, may be greatly augmented.

While on this part of our subject, it may be proper to state, that it is in almost every instance strongly advisable to form a large reservoir, and to uphold a sufficient quantity of water, by means of a dam, &c. to afford a supply in case of long-continued drought. Such an excess can rarely prove inconvenient; the only cases in which it might perhaps not be eligible are, where the supply may be considered as infallible, or the expense prove too great a drawback on the profits of the concern.

We shall now give a description of a double corn mill, of the most common sort. See Plate Mill-Work.

A B is a water-wheel, which is overshot 11 feet 6 inches in diameter, with 36 buckets to receive the water, whose weight puts it in motion. The wheel is fixed upon a very strong axis or shaft, C, one end of which rests on D, and the other on E, within the mill-house. On this shaft or axis, and within the mill-house, is a wheel, F, about 8 or 9 feet in diameter, having cogs, 72 in number, all round, which work in 23 upright staves, or rounds of a trundle, G, fixed on a strong upright shaft, T, which has a cog-wheel, W, with 56 teeth fixed on its upper end, to give a rotatory motion to the two small trundles, *g g*, on each side, and which are exactly similar to each other. Each trundle is fixed upon a strong iron axis, called the spindle, the lower end of which turns in a brass foot fixed at H, in a horizontal beam, H, called the bridge-tree; the upper end of the spindle turns in a wooden bush, fixed into the nether millstone, which lies upon the beams in the floor, I. The top of the spindle above the bush is square, and goes into a square hole in a strong iron cross, *a*, *b*, called the rynd, under which, and close to the bush, is a round piece of thick leather upon the spindle, which it turns round at the same time as it does the rynd. The rynd is let into grooves in the under surface of the running millstone, K, and so turns it round in the same time as the trundle, *g*, is turned round by the cog-wheel, W: this millstone has a large hole quite through its middle, called the eye of the stone, through which the middle part of the rynd and upper end of the spindle may be seen, whilst the four ends of the rynd lie below the stone in their grooves. One end of the bridge-tree, which supports the spindle, rests upon the wall, whilst the other is let into a beam called the brayer, L, M. The brayer rests in the wall at L; the other end, M, hangs by a strong iron rod which goes through the floor, I, and has a screw-nut at its top; by the turning of which nut the end, M, of the brayer is raised or depressed at pleasure, and consequently the bridge-tree and the upper millstone. By this means the upper millstone may be set as close to the under one, or raised as high from it, as the miller pleases. The nearer the millstones are to each other the finer the corn is ground, and the more remote from one another the coarser. The upper millstone is inclosed in a round box, which does not touch it any where, and is about an inch distance from its edge all round. On the top of this box stands a frame for holding the hopper, P, to which is hung the shoe, Q, by two lines fastened to the hinder part of it, fixed upon hooks in the hopper, and by one end of the string, R, fastened to the forepart of it; the other end being twisted round a pin, in a convenient place, within the reach of the miller; as the pin is turned one way, the string draws up the shoe closer to the hopper, and so lessens the aperture between them; and as the pin is turned the other way, it lets down the shoe and enlarges the aperture.

If the shoe is drawn up quite to the hopper, no corn can fall from the hopper into the mill; if it is let down a little, some will fall, and the quantity will be more or less, according as the shoe is more or less let down; for the hopper is open at the bottom, and there is a hole in the bottom of the shoe, not directly under the bottom of the hopper, but nearer to the lower end of the shoe, over the middle eye of the mill-stone. There is a square on the top of the spindle, on which is put the feeder, *f*; this feeder, as the spindle turns round, jogs the shoe three times in every revolution, and so causes the corn to run constantly down from the hopper, through the shoe, into the eye of the millstone, where it falls upon the top of the rynd, and is, by the motion of the rynd and the leather under it, thrown below the upper stone, and ground between it and the lower one. The violent motion of the stone creates a centrifugal force in the corn going round with it, by which means it gets further and further from the centre, as in a spiral, in every revolution, until it is quite thrown out, and being then ground, it falls through a spout, called the mill-eye, into a trough placed to receive it.

When the mill is fed too fast, the corn bears up the stone and is ground too fast, and besides it clogs the mill so as to make it go too slow; when the mill is too slowly fed, it goes too fast; and the stones by their attrition, are apt to strike fire: both these inconveniences are avoided by turning the pin backward or forward, which draws up or lets down the shoe, and thus regulates the feeding as the miller sees convenient.

It affords us pleasure in being able to lay before the reader reduced copies of two designs for water-wheels, by the late Mr. John Smeaton, and which we have obtained from Sir Joseph Banks, K. B. who has permitted our draughtsmen to make copies of Mr. Smeaton's original drawings, which are in his possession. The first is an undershot water-wheel. See fig 1. Plate II. Mill-work.

A is the main shaft, or axis, upon which the wheel turns, and which communicates its power to the interior mechanism of the mill: *a a a a* are six arms morticed into this shaft, and supporting the rim, *b b* of the wheel; into this rim the starts, *e e*, are morticed; these are short pieces of wood, to which the float boards, *f f*, are nailed; it is by the action of the water upon these that the wheel is turned: *g g* are boards fixed obliquely, and extending from one float to the next; they are to prevent the water passing through the wheel without acting upon it. B B is a circular breasting or sweep, which is made to fit to the wheel as close as possible without touching, so that very little water may escape; the ends of the boards also fit the sides of the wheel-race, or trough, in the same manner. D D is the crown of the breasting, which is a segment of a circle. And *d* is the shuttle, by which the quantity of water going to the wheel is regulated, and consequently its power. There are two of the rims, *b b*, (though only one is seen, the other being behind it) with separate sets of arms and starts, to support the float-boards at each end; and in some very broad wheels three rings are employed.

Figure 2. is an overshot water-wheel, as designed by Mr. Smeaton, and generally recommended by him in the latter years of his business.

A is the main shaft, with two sets of clasp arms embracing it, and supporting two rings (one only of which, *a a*, is seen, the other being behind it) parallel to each other, and at the distance apart of the breadth of the wheel: *b b* are a number of boards nailed down to the rings at their ends, in the same manner as flooring-boards are nailed upon the joists, and forming, upon the wheel, a complete cylinder: on each of the ends of these boards a circular ring, *d d*, is fixed, and between these the boards, forming the buckets are fastened, by having their ends let into grooves made in the inside of the rings *d d*; the bucket-boards are each composed of two pieces, as is sufficiently explained in the figure. The pen-trough, which brings the water to the wheel, is next to be described; it is a long square trough, B B, with a hole in its bottom at one end, through which it delivers its water upon the wheel: *e* is a board called the shuttle, covering this hole, and made to fit water-tight upon the bottom of the trough by leather; it is drawn backwards or forwards by a rod connecting it with a lever, *f*, by which the miller can draw it: *h* is a beam across the pen-trough: and *k*, an iron bolt to support the bottom of the trough; the edge of the hole over which the water runs, is the distance of one bucket beyond the perpendicular line going through the centre of the wheel; and it is formed of iron plate, with a sharp edge, to avoid dropping; the edge of the shuttle is also covered with iron plate, that the water may be delivered clean, and in one entire sheet. The first-mentioned iron plate is bent so as to deliver the water nearly horizontally. The wheel is inclosed in a close breasting of stone, D D.

Attempts have been made to construct water-wheels which receive the impulse obliquely, like the sails of a common wind-mill. By this means a slow but deep river could be made to drive our mills; though much power would be lost by the obliquity. Dr. Robison describes one that was very powerful; it was a very long cylindrical frame, having a plate standing out from it, about a foot broad, and surrounding it with a very oblique spiral, like a corkscrew. This was immersed nearly a quarter of its diameter (which was 12 feet), having its axis in the direction of the stream. By the work performed, it seemed more powerful than a common wheel that occupied the same breadth of the river. Its length was not less than 20 feet: had it been twice as long, it would have nearly doubled its power, without occupying more of the water-way. Perhaps such a spiral continued quite to the axis, and moving in a suitable canal, wholly filled by the stream, might be an advantageous way of employing a deep and slow current.

An undershot mill, with oblique float-boards, was invented by the late Mr. Besant of Brompton; it promises to be of great service in some situations. In common water-wheels, more than half the quantity of that fluid passes from the gate through the wheel without affording it any assistance: the action of the floats is resisted by the incumbent atmosphere, at the moment when these leave the tail-water; and as a similar proportion of water, with that which passed between the floats and the head, necessarily flows between them at the tail, the motion of the wheel is greatly impeded. On the contrary, by Mr. Besant's contrivance, no water can pass, except that which acts with all its force on the extremity of the wheel; and, as the floats emerge from the water in an oblique direction, the weight of the atmosphere is thus prevented from taking any effect. A great advantage of this construction is, that the wheel works are lighter, owing to a tendency to floating. When working in deep tail-water it is decidedly superior, carrying weight in the proportion of three to one

Messrs. Polfreeman and Co. lately purchased the patent-right given to Mr. Hawkins for his invention of floating water-mills, and established one, by permission of the Board of Navigation, on the Thames. This kind of mill might be more generally used, with great advantage to the public; and, in lieu of being constructed as tide-mills (which require that the work should all revolve, either with or against the sun), would, perhaps, be something improved by allowing the hulks, in which they are built, to swing round, like vessels at single anchor, in the tide's way.

Mills, *wind,* are, in their general construction, much the same as water-mills; adverting to the difference of the power by which they are acted upon. The external apparatus consists chiefly of the sails, or vanes, which are commonly four, placed in nearly a vertical position, and giving, as they turn, a rotatory motion to an axis inclining but little from the horizon. The form of the arms and vanes being so well known, we shall refrain from describing them in this place.

The direction of the wind being extremely uncertain, it becomes necessary to have some contrivance for turning the sails towards it; for this purpose two modes are in more general use. In one, the whole machine is sustained upon a moveable arbor or axis, perpendicular to the horizon, and supported by a strong stand, or foot, very firmly fixed in the earth: thus, by means of a lever, the whole may be turned round to any direction. In the other way, only the upper part is moveable: the roof being a kind of cap, joining to the axis, on which the sails, or vanes, are fixed, and working round by means of an endless screw, that acts upon a ratchet frame, embracing the lower part of the cap. The former mode applies chiefly to what are called post-mills; the latter, to fixed-mills built of masonry.

We offer the following table of velocity and power, resulting from the experiments of Mr. Smeaton, and confirmed by Dr. Hutton, Mr. Rouse, &c. By it our readers will be able to compute to any extent, when on the subject of the wind's progress.

VELOCITY OF THE WIND.		Perpendicular Force on one Square Foot in Avd. Pounds.
Miles in one Hour.	= Feet in one Second.	
1	1.47	.005
2	2.93	.020
3	4.40	.044
4	5.87	.079
5	7.33	.123
10	14.67	.492
15	22.00	1.107
20	29.34	1.968
25	36.67	3.075
30	44.01	4.429
35	51.34	6.027
40	58.68	7.873
45	66.01	9.963
50	73.35	12.300
60	88.02	17.715
80	117.36	31.490
100	146.70	49.200

Whatever varieties may arise as to the internal structure of windmills, there are certain rules with regard to the position, shape, and magnitude of sails, which will bring them into the best state to receive the action of the wind, and to produce a full effect. M. Parent set his sails, or vanes, at an angle of 55° from the axis on which they project; and that would have certainly proved the best, if no other object than the acquisition of a certain degree of velocity had been desirable; but we find that from 72° to 75° gives a greater power; consequently, in their general application, vanes standing at that angle, or within one or two degrees more or less, are best calculated to produce a sufficient impetus for light breezes.

Mr. Smeaton made several experiments, which gave results proving the hypothesis just stated. He had vanes set at the following angles, and found it better to give an excess of retirement from, than an excess of exposure to, the wind.

No.	Angle with the axis.	Angle with the Plane of Motion.
1	72°	18°
2	71	19°
3	72	18° in the middle.
4	74	16°
5	77½	12°½
6	83	7° at the extremity.

He also tried the effects of a greater expanse of surface upon the same radius; the result was, that a broader sail, in all cases, required a larger angle; and that frustrated pyramidal sails, having their bases outwards, were more powerful than parallelograms, the extreme or outer bar being one-third the depth of the whip, or vane staff. Attempts were made to fill the whole space with sails; but it was evident, that, for want of sufficient passage for the wind, the intention was not fulfilled: when more than seven-eighths of the area was spread with sail, there was an immense pressure, which caused much friction and imminent danger, while the velocity was rather diminished than augmented. Length of sail is a great object, so far as relates to the acquisition of power, but where an excess prevails, many injuries are sustained; notwithstanding the boom and guys, used in many places for the support of long arms.

As water-mills are, in general, stopped by shutting out the water, and thus debarring further influence of the power at pleasure; so windmills are commonly stopped by a pinch, or pressure, on the axis bearing the vanes. Some are likewise acted upon by a weight which tends to retard the motion, and so slackens the rotation as to enable the pinch to have more effect. We have seen instances where the great axle could be cast off in an instant; so that, although the vanes might continue to go round, the interior movements were stopped. This is an excellent contrivance, and may often save a mill from being burnt, when by accident, or neglect, the stones have come in contact, and produced collisive sparks. But in such case, it is obvious that a sufficient counter-check should be created to retard the motion of the vanes; else they would, from want of due opposition, move round with great rapidity, and produce other dangers no less imminent. This prevention is easily effected, by causing the lever, which raises the main axle, to act against a stiff-set wheel, capable of checking its progress.

Some mills have a weathercock placed in the line with the axis, projecting several feet, and having sufficient surface to cause the cap to move round, so as always to keep the butt of the axle direct to the wind. This is an admirable expedient, inasmuch as it effectually answers the intention, and supersedes the necessity for the miller's constant attention to the wind; which, when variable, occasions considerable interruption to other avocations, and may, eventually, be attended both with loss of time and some damage.

Mr. John Bywater, of Nottingham, obtained a patent for clothing and unclothing the sails of windmills while in motion: his contrivance was nothing more than causing them to roll up lengthwise, by means of small wheels or ratchets, placed near the axis, and acted upon by it in its revolution.

Mills, *horizontal wind*, have likewise been tried, but they are both troublesome to manage and deficient in power: on the other hand, they are far safer, and cheaper in their construction than the vertical kind. The simplest mode of constructing a windmill is with a spiral sail, passing round a centre pole, tapering towards the summit, and spreading to a great width at the base. This certainly has not very great powers, but acts with great uniformity, and requires no attendance, since it matters not from what quarter the wind blows. We consider this machine to be very well calculated for raising water from fens, &c. both on account of its cheapness and its safety, even in the most exposed situations. The pole, or axis, to which the sail is fastened all the way up, being perpendicular, and every part presented to the wind giving it a tendency to rotation, while the main part being below, insures a steady action, and that absence of violent friction which cannot be effected in a vertical mill, or in any machine, where the greater part of the power is derived from the extremities of long arms or vanes. See Windmill.

Mills, *horse* and *hand*, are usually upon a small construction, rarely calculated to produce any considerable effect, and more appropriate to domestic purposes of inferior consideration. These machines, as their names imply, derive their action from animal force, which is unquestionably the dearest, most irregular, and least efficient, of all the powers hitherto applied to mechanism. In horse-mills, one, two, or more horses, or other cattle, are made either to draw, or push before them, levers, which project from a centre shaft, bearing the great horizontal wheel that gives motion to the more remote parts, and which act with more or less effect, according to the length of the levers, and the number of cattle employed. For threshing, drawing water, grinding, polishing, &c. such a power answers as a substitute where water is not at command. But, owing to the inequality of pace, and to the great propensity all animals have to lean towards the centre (in lieu of moving with freedom along the given circle of perambulation,) all machines worked by cattle invariably become speedily deranged, and are encumbered with an excess of friction. Hand-mills labour under a similar inconvenience: though such as are regulated by fly-wheels, which occasion a great accumulation of force, and at the same time dispose to a degree of regularity in its action, are both more efficient and more durable. Of these we have numbers, such as chaff-cutting machines, grindstones, &c.; indeed, the mangle may be included among this class. In several countries, the whole of the flour, meal, &c. used by the natives, are produced by means of hand-mills; our legislature, however, considering these as drawbacks on the livelihood of a very numerous class, has prohibited their use under very heavy penalties. In many parts of Scotland the tenants are generally thirled, *i. e.* invariably obliged to send whatever corn they wish to grind to some particular mill; any deviation is actionable. This was at one time, perhaps, necessary, for the encouragement of millers, when they first introduced water machinery into that kingdom; at present it operates not only as an inconvenience, but, in many instances, as a hardship, amounting nearly to a prohibition. The evil, however, sometimes carries its own remedy, for the tenants sell their corn to the owner of some other neighbouring mill; and, when it is ground, buy the flour it produced: thus they evade the thirling, which binds only to the grinding of what they do not dispose of.

Mills, *bark*, are most frequently worked by cattle, and perform their office by means either of large beams called beetles, which being lifted in successive order fall into cavities wherein the bark, previously dressed in a proper manner, is placed, and pounds it to a sufficient degree of fineness to answer the tanner's purpose. Madder, and many other articles used in various trades are also broken in the same manner. Paper is made from rags, which being dusted in sieves, &c. and soaked, are macerated in a mill, which tears the several fibres apart, and reduces the whole to a fine pulp.

Mills, *coffee* and *pepper*, are too well known to require detail; we were not a little surprised to find the ordinary machinery of this class, when extended to a very large scale, obtain a patent for the grinding of bark.

Mills, *oil*, are very simple in their construction, they being nearly the same as cyder-mills; consisting of troughs wherein the seed is broken by the passage of immense cylinders, or cones, of iron or stone, and afterwards put into presses for the purpose of forcing the oil from the residuum; which is sold under the name of oil-cake, for the purpose of fatting cattle.

Mills, *copper* and *brass*, are almost invariably worked by water, having large wheels that give immediate action to hammers of great weight, some being near three hundred weight; these beat out the large slabs and bricks of metal into various forms, such as kettles, coppers, boilers, &c. and roll out sheets for various purposes, but especially for coppering the bottoms of ships. This process is effected by passing the heated metal between two cast-iron cylinders, of about a foot diameter, which, having contrary motions, draw it through a small interval left between them; and, by reducing the thickness, give greater surface to the sheet. In this manner the metal may be brought to any degree of thinness; the workmen bringing the cylinders nearer to each other, by means of screws at each end, every time a plate has been passed. The same mills have shears, worked by offsets from the counter-wheels, that cut the edges of the plates perfectly even, and are sufficiently forcible to divide lumps of copper, full an inch thick, and six or seven in breadth, at one cut, the metal being previously brought to a red heat.

Mills, *silk*, *cotton*, &c. require much delicacy in their construction; their principal movements depend on the same principles as those of the mills described in the plate; the more minute parts, such as the bobbins, &c. being moved by means of one or more leather straps passing them in close contact, so as to occasion them to revolve with an astonishing degree of velocity.

Mills, *saw*, though extremely simple in their parts, require the greatest care in their formation. The saws, which are moved by cranks (much the same as those in use for pumps in water works), must be set with most scrupulous exactness, else they will not only tear obliquely, and destroy much wood, but create such an accumulation of friction, as must deteriorate the powers of the machine so as to approach the equilibrium. In most instances, the timber is brought forward to the saw by means of a small toothed wheel, and an axle, whereon the rope that pulls the timber is gradually coiled. See Saw-mill.

Mills, *flax*, are generally worked by cattle; their construction is simple; the essential parts being the hackle, which combs the flax; and the scutcher, which strikes it: both tend to clearing away the coarser and unequal fibres, and to prepare the material for being spun, either by hand, or by means of machinery.

We feel some surprise at the neglect shewn towards a very ingenious and useful invention in the department of mill-work; *viz.* the action of wheels, mutually, without the aid of cogs, or teeth. We have instances of wheels having been worked for nearly 30 years, simply by means of contact: the fellies (or circumference) being made of pieces of wood, having their grain, or fibres, all pointing to the centre. This produces a certain degree of roughness, exteriorly, which causes two wheels, thus formed, to bind sufficiently for the purposes of communicating rotation, where the stress is not excessive; and even in that case, much may be effected by causing the wheels to bear very hard against each other, so as to excite friction to such an extent as may overcome the resistance of the weight, &c. We have seen a spinning machine consisting only of a vertical wheel (turned by a foot-lathe), that had its perimeter armed with a band of stout buff-leather; which coming in contact with a number of bobbins, &c. caused all to move with great rapidity. Each bobbin was under the care of a little girl, who, by means of a slider, could either set it to work by approximation to the wheel, or liberate it from agency by withdrawing it from contact.

Having said thus much on the subject of mill-work, we beg leave to refer those of our readers, who may be in search of abstruse knowledge, to Olinthus Gregory's work on the Theory of Mechanics; and to the excellent practical treatise of the late Mr. Smeaton, for a great variety of experiments, not only in this, but in many other most important branches of mechanics; which the limits of our volumes do not permit us to enter upon in any other than a brief, summary, and popular manner.

Mill. From and after July 1, 1796, every miller shall have in his mill a true balance, with proper weights; and every miller, in whose mill shall be found no balance or weights, shall forfeit not exceeding 20*s*.

Every person may require the miller to weigh, in his presence, the corn before it shall be ground, also after it shall be ground; and if he refuse, he shall forfeit not exceeding 40*s*. Every miller shall, if required, deliver the whole produce of the corn, allowing for the waste in grinding and toll, when toll is hereinafter allowed to be taken, on pain to forfeit not exceeding 1*s*. per bushel, and treble the value of the deficiency. Where toll is allowed to be taken, it shall be deducted before the corn is put into the mill. From and after June 1, 1796, no miller shall, under the penalty of 5*l*. take any part of the corn, or of the produce, for toll; but in lieu thereof he shall be entitled to demand payment in money. But where the party shall not have money to pay for grinding, the miller, with his consent, may take such part of the corn as will be equal to the money price, expressed in their table of prices for grinding. Also, nothing in this clause shall extend to the ancient mills called soke-mills, or such others where the possessors are bound to grind for particular persons, or within particular districts, and to take a fixed toll.

From and after June 1, 1796, every miller shall put up in his mill a table of the prices, or of the amount of toll at his mill, on pain of forfeiting not exceeding 20*s*.

MILLEPES, the common *wood-louse*, a species of the oniscus, with a blunt forked tail. See Oniscus.

MILLEPORA, in natural history, a genus of insects of the Vermes Zoophyta class and order. Animal an hydra or polype; coral mostly branched, and covered with many cylindrical turbinated pores; hence its name, a thousand pores. There are more than thirty species, of which we shall notice M. miniacea, very minute, branching into small lobes, and covered with very small pores. This is an inhabitant of the Mediterranean and Indian Seas; is a beautiful little coral, and the smallest of the genus, being seldom more than a quarter of an inch high; the whole surface when magnified appears full of white blind pores, and on the tops of the lobes are several scattered holes surrounded with a margin; the base is broad, by which it adheres to shells, corals, and rocks. M. cervicornis; a little compressed, dechotomous, with cells on both sides, and tubular, somewhat prominent florets. It is found in the Mediterranean and on the Cornish coast five or six inches high; reddish or yellowish brown, branched like the horns of a stag, and appearing as if covered with varnish. M. polymorpha; crustaceous, solid, irregularly shaped, but generally branched and tuberculate, and without visible pores; inhabits most European seas, and is the common coral of the shops; in many places it grows in such abundance that it is burnt for manure; its colour is either red, yellowish green, and sometimes white. It is frequently shaped like a walnut, often in large compressed masses. sometimes like a small bunch of grapes, but most frequently in short irregular ramifications, of a chalky tuberculate appearance and stony substance.

MILLERIA, in botany, so named in honour of Philip Miller, author of the Gardener's Dictionary and Calendar; a genus of the Syngenesia Polygamia Necessaria class and order. Natural order of Compositæ Oppositifoliæ. Corymbiferæ, Jussieu. Essential character: calyx, three-valved; ray of the corolla halved; down none; receptacle naked. There are three species: of which M. biflora, two-flowered milleria, is an annual plant, rising with an herbaceous stalk upwards of two feet high, branching out at a small distance from the root into three or four slender stalks, which are almost naked to the top, where they have two lanceolate leaves placed opposite, nearly two inches long; they have three longitudinal veins, and are slightly indented on their edges; the flowers come out at the foot-stalks of the leaves, in small clusters; the common calyx is composed of three orbicular leaves, compressed together: in each of these are two imperfect hermaphrodite florets, which are barren; and one female ligulate fruitful floret, to which succeeds a roundish angular seed, inclosed in the calyx. This plant was discovered at Campeachy, by Dr. Houston.

MILLET. See Milium.

MILLING, in the manufacture of cloth, the same with fulling. See Fulling.

MILLION, in arithmetic, the number of ten hundred thousand, or a thousand times a thousand.

MILREE, a Portuguese gold coin, equal to *5s. 7½d.* of our money.

MIMOSA, in botany, a genus of the Polygamia Monoecia class and order. Natural order of Lomentaceæ; Leguminosæ, Jussieu. Essential character: hermaphrodite, calyx five-toothed; corolla five-cleft; stamina five or more; pistillum one; legume: male, calyx five-toothed; corolla five-cleft; stamina five, ten, or more. There are eighty-five species; among which the M. sensitiva, sensitive plant, rises with a slender woody stalk seven or eight feet in height, armed with short recurved thorns; the leaves grow upon long foot-stalks, which are prickly, each sustaining two pair of wings; from the place where these are inserted come out small branches, having three or four globular heads of pale purplish flowers, coming out from the side, on short peduncles; the principal stalk has many of those heads of flowers on the upper part, for more than a foot in length; this, as also the branches, is terminated by like heads of flowers: the leaves move but slowly when touched, but the foot-stalks fall, when they are pressed pretty hard. It is a native of Brazil. M. pudica, humble plant, has the roots composed of many hairy fibres, which mat closely together; from these come out several woody stalks, declining towards the ground, unless supported; they are armed with short recurved spines, having winged or pinnate leaves; flowers from the axils, on short peduncles, collected in small globular heads, of a yellow colour. "Naturalists," says Dr. Darwin, "have not explained the immediate cause of the collapsing of the sensitive plant; the leaves meet and close in the night during the sleep of the plant, or when exposed to much cold in the day-time, in the same manner as when they are affected by external violence, folding their upper surfaces together, and in part over each other, like scales, or tiles, so as to expose as little of the upper surface as may be to the air; but do not, indeed, collapse quite so far; for when touched in the night during their sleep, they fall still further; especially when touched on the foot-stalks between the stems and the leaflets, which seems to be their most sensitive, or irritable part. Now as their situation after being exposed to external violence resembles their sleep, but with a greater degree of collapse, may it not be owing to a numbness or paralysis consequent to too violent irritation, like the faintings of animals from pain or fatigue? A sensitive plant being kept in a dark room till some hours after day-break, its leaves and leaf-stalks were collapsed as in its most profound sleep; and on exposing it to the light, above twenty minutes passed before the plant was thoroughly awake, and had quite expanded itself. During the night the upper surfaces of the leaves are oppressed; this would seem to show that the office of this surface of the leaf was, to expose the fluids of the plant to the light as well as to the air."

Dr. Darwin has thus characterized these plants.

> "Weak with nice sense the chaste Mimosa stands,
> From each rude touch withdraws her timid hands;
> Oft as light clouds o'erpass the summer glade,
> Alarm'd she trembles at the moving shade;
> And feels alive through all her tender form,
> The whisper'd murmurs of the gathering storm;
> Shuts her sweet eyelids to approaching night,
> And hails with freshen'd charms the rising light."

MIMULUS, in botany, *Monkey flower*, a genus of the Didinamia Angiospermia class and order. Natural order of Personatæ. Scrophulariæ, Jussieu. Essential character: calyx four-toothed, prismatical: corolla ringent; the upper lip folded back at the sides: capsule, two-celled, many-seeded. There are four species, natives of North and South America.

MIMUSOPS, in botany, a genus of the Octandria Monogynia class and order. Natural order of Holoraceæ. Sapotæ, Jussieu. Essential character: calyx four-leaved; petals four; nectary sixteen-leaved; drupe acuminate. There are three species, of which M. elengi is a middle sized tree, with entire smooth leaves; flowers axillary, on many simple peduncles; calyxes tomentose; berry superior; defended at the base by the permanent calyx, having an obsolete groove on one side, shagreened all over with very minute callous dots. It is a native of the East Indies, where it is much cultivated on account of its fragrant flowers, which come out chiefly in the hot season.

MINA, in Grecian antiquity, a money of account, equal to an hundred drams.

MIND. See PHILOSOPHY *of the Mind*.

MINE, in natural history, a place under ground, where metals, minerals, or even precious stones, are dug.

As, therefore, the matter dug out of mines is various, the mines themselves acquire various denominations, as gold-mines, silver-mines, copper-mines, iron-mines, diamond-mines, salt-mines, mines of antimony, of alum, &c.

Mines, then, in general, are veins or cavities within the earth, whose sides receding from, or approaching nearer to each other, make them of unequal breadths in different places, sometimes forming larger spaces, which are called holes: they are filled with substances, which, whether metallic or of any other nature, are called the loads: when the substances forming these loads are reducible to metal, the loads are by the miners said to be alive; otherwise they are called dead loads. In Cornwall and Devon, the loads always hold their course from eastward to westward; though in other parts of England they frequently run from north to south. The miners report, that the sides of the load never bear in a perpendicular, but constantly underlay, either to the north or to the south. The load is frequently intercepted by the crossing of a vein of earth or stone, or some different metallic substance; in which case it generally happens, that one part of the load is moved a considerable distance to the one side. This transient load is by the miners called flooking: and the part of the load which is to be moved is said to be heaved. According to Dr. Nichols's observations upon mines, they seem to be, or to have been, the channels through which the waters pass within the earth, and, like rivers, have their small branches opening into them, in all directions. Most mines have streams of water running through them; and when they are found dry, it seems to be owing to the waters having changed their course, as being obliged to it, either because the load has stopped up the ancient passages, or that some new and more easy ones are made. Mines, says Dr. Shaw, are liable to many contingencies; being sometimes poor, sometimes soon exhaustible, sometimes subject to be drowned, especially when deep, and sometimes hard to trace; yet there are many instances of mines proving highly advantageous for hundreds of years: the mines of Potosi are to this day worked with nearly the same success as at first; the gold-mines of Cremnitz have been worked almost these thousand years; and our Cornish tin-mines are extremely ancient. The neat profit of the silver alone, dug in the Misnian silver-mines in Saxony, is still, in the space of eight years, computed at a thousand six hundred and forty-four millions, besides seventy-three tons of gold. Many mines have been discovered by accident: a torrent first laid open a rich vein of the silver-mine at Friberg in Germany; sometimes a violent wind, by blowing up trees, or overturning the parts of rocks, has discovered a mine; the same has happened by violent showers, earthquakes, thunder, the firing of woods, or even the stroke of a plough-share, or horse's hoof.

But the art of mining does not wait for these favourable accidents, but directly goes upon the search and discovery of such mineral veins, ores, or sands, as may be worth the working for metal. The principal investigation and discovery of mines depend upon a particular sagacity, or acquired habit of judging from particular signs, that metallic matters are contained in certain parts of the earth, not far below its surface. The principal signs of a latent metallic vein seem reducible to general heads, such as, 1. The discovery of certain mineral waters. 2. The discoloration of the trees or grass of a place. 3. The finding of pieces of ore on the surface of the ground. 4. The rise of warm exhalations. 5. The finding of metallic sands, and the like. All which are so many encouragements for making a stricter search near the places where any thing of this kind appears; whence rules of practice might be formed for reducing this art to a greater certainty. But when no evident mark of a mine appears, the skilful mineralogist usually bores into the earth, in such places as from some analogy of knowledge, gained by experience, or by observing the situation, course or nature of other mines, he judges may contain metal: this method of boring we have already given under the article Boring.

After the mine is found the next thing to be considered is whether it may be dug to advantage. In order to determine this, we are duly to weigh the nature of the place and its situation, as to wood, water, carriage, healthiness, and the like, and compare the result with the richness of the ore, the charge of digging, stamping, washing, and smelting.

Particularly the form and situation of the spot should be well considered. A mine must either happen, 1. In a mountain. 2. In a hill. 3. In a valley. Or, 4. in a flat. But mountains and hills are dug with much greater ease and convenience, chiefly because the drains and burrows, that is, the adits or avenues, may be here readily cut, both to drain the water and to form gangways for bringing out the lead, &c. In all the four cases we are to look out for the veins, which the rains, or other accidental thing, may have laid bare; and if such a vein be found, it may often be proper to open the mine at that place, especially if the vein prove tolerably large and rich: otherwise the most commodious place for situation is to be chosen for the purpose, *viz.* neither on a flat, nor on the tops of mountains, but on the sides. The best situation for a mine, is a mountainous, woody, wholesome spot, of a safe easy ascent, and bordering on a navigable river. The places abounding with mines are generally healthy, as standing high, and every where exposed to the air; yet some places where mines are found, prove poisonous, and can, upon no account, be dug, though ever so rich: the way of examining a suspected place of this kind is, to make experiments upon brutes, by exposing them to the effluvia or exhalations, to find the effects.

Mine, in fortification, &c. is a subterraneous canal or passage, dug under any place or work intended to be blown up by gunpowder. The passage of a mine leading to the powder is called the gallery; and the extremity, or place where the powder is placed, is called the chamber. The line drawn from the centre of the chamber, perpendicular to the nearest surface, is called the line of least resistance; and the pit or hole, made by the mine, when sprung or blown up, is called the excavation. The mines made by the besiegers in the attack of a place are called simply mines; and those made by the besieged, countermines. The fire is conveyed to the mine by a pipe or hose, made of coarse cloth, of about an inch and half in diameter, called saucisson, extending from the powder in the chamber to the beginning or entrance of the gallery, to the end of which is fixed a match, that the miner who sets fire to it may have time to retire before it reaches the chamber. It is found by experiments, that the figure of the excavation made by the explosion of the powder is nearly a paraboloid, having its focus in the centre of the powder, and its axis the line of least resistance; its diameter being more or less, according to the quantity of the powder, to the same axis, or line of least resistance.

MINERAL *waters.* See Waters, *mineral.*

MINERALIZER, a name to any substance found in natural combination with a metal; thus lead is said to be mineralized by sulphur, when combined with it in the native sulphuret.

MINERALOGY, that science which teaches us the properties of mineral bodies, and by which we learn how to characterize, distinguish, and class them into a proper order. Mineralogy seems to have been in a manner coeval with the world. Precious stones of various kinds appear to have been well known among the Jews and Egyptians in the time of Moses; and even the most rude and barbarous nations appear to have had some knowledge of the ores of different metals. As the science is nearly allied to chemistry, it is probable that the improvements, both in chemistry and mineralogy, have nearly kept pace with each other; and indeed it is but of late, since the principles of chemistry were well understood, that mineralogy has been advanced to any degree of perfection The best way of studying mineralogy, therefore, is by applying chemistry to it; and not contenting ourselves merely with inspecting the outsides of bodies, but decomposing them according to the rules of chemistry. This method has been brought to the greatest perfection by M. Pott of Berlin, and after him by Mr. Cronstedt of Sweden. To obtain this end, chemical experiments in the large way are, without doubt, necessary; but as great tracts of the mineral kingdom have been examined in this manner by different writers, the curious mineralogist need not repeat those experiments in their whole extent. An easy way may be adopted, which even for the most part is sufficient, and the processes of which, though made in miniature, are as scientifical as the common manner of proceeding in the laboratories, since it imitates that, and is also founded on the same principles. This method consists in making the experiments upon a piece of charcoal, with the concentrated flame of a candle directed through a blow-pipe. The heat occasioned by this is very intense, more especially if a stream of oxygen gas be thrown upon the subject under examination; and the different mineral bodies may thus be burnt, calcined, melted, and scorified, &c. as well as in any great furnace. When earths or stones are to be tried, it is improper to begin immediately with the blow-pipe: some preliminary experiments ought to be made, by which those in the fire may afterwards be directed. For instance, a stone is not always homogeneous, or of the same kind throughout, although it may appear to the eye to be so. A magnifying glass is therefore necessary to discover the heterogeneous particles, if there be any; and these ought to be separated, and every part tried by itself, that the effects of two different things, examined together, may not be attributed to one alone. This might happen with some of the finer micæ, which are now and then found mixed with small particles of quartz, scarcely to be perceived by the eye. The trapp is also sometimes mixed with very fine particles of feltspar, or of calcareous spar, &c. After this experiment, the hardness of the stone in question must be tried with steel. The flint and garnets are commonly known to strike fire with steel; but there are also other stones, which though very seldom, are found so hard as likewise to strike fire. There is a kind of trapp of that hardness, in which no particles of felt spar are to be seen. Coloured glasses resemble true gems; but as they are very soft in proportion to these, they are easily discovered by means of the file. The common quartz-crystals are harder than coloured glasses, but softer than the gems. The loadstone discovers the presence of iron, when it is not mixed in too small a quantity in the stone, and often before the stone is roasted. Some kinds of hæmatites, and particularly the cerulean, greatly resemble some other iron ores; but this distinguishes itself from them by a red colour when pounded, the others giving a blackish powder, and so forth.

In a work of this magnitude we cannot enter much at large into historical details; it may, however, be proper to notice in brief the principal different systems that have been given to the world.

The system of Cronstedt was published in 1758, and for twenty years was generally received by the scientific world. In 1780, a translation of Cronstedt's mineral system appeared in Germany, accompanied with notes, by Werner, the Professor of Mineralogy at Freyberg in Saxony. Six years before, the professor had published a separate treatise on the classification of minerals, in which he exhibited much skill in a method of describing them by means of external characters. Werner's method is chiefly, if not wholly followed in Germany, and is highly regarded in this and other countries. This system was introduced here by Mr. Kirwan, in 1784, who further elucidated it some years afterwards by a new and much enlarged addition of his work. In preparing the latter edition, Mr. Kirwan had the advantage of consulting one of the completest and best arranged collections of minerals which had been made in any country. This was collected by Leske, and after him is called the Leskean collection. It was arranged between the years 1782-1787, according to the principles of Werner, and with his assistance. After the death of Leske, a catalogue of it was drawn up, which is divided into five parts: the first, which is denominated the characteristic part, consists of specimens intended for the illustration of the external characters of the classification. The second, which is the systematic or oryctognostic part, comprehends all simple minerals, distributed according to their genera and species, agreeably to the method at that time followed by Werner. The next is the geognostic geological part, which includes the substances found in the different kinds of rocks, as they are divided into primitive, transition, stratiform, alluvial, and volcanic mountain. This part of the collection is very rich in petrifactions. The fourth part is intended to illustrate the mineralogy of every country on the globe, by exhibiting its mineral productions. The fifth part is called the economical collection, and is formed of specimens which are employed in arts and manufactures, as in architecture, sculpture, agriculture, jewellery, dyeing, clothing, pottery, glazing, enamelling, polishing of metals, furnace-building, medicine, metallurgy, &c. This short account of a very valuable collection may be a guide to collectors and amateurs in the science. In France, the mineralogical treatises of Brochant, Hauy, and Brougniart, may be noticed; these have already been referred to in the course of our volumes, but claim a distinct enumeration here. The system of Brochant is formed on the principles of Werner's classification, and is thought to be the most perspicuous account of the German mineralogy that has yet been published. The system of Hauy divides itself into four classes. The first class consists of substances which are composed of an acid united to an earth and alkali, and sometimes to both. The second class includes only earthy substances, but sometimes combined with an alkali: it constitutes the silicious genus of other systems. The third class comprehends combustible substances which are not metals. The metals form the fourth class. This is divided into three orders, which are characterized by different degrees of oxydation. Besides these classes, there are three appendices. The first contains those substances, the nature of which is not sufficiently known to have their places accurately assigned in the system. The second appendix includes aggregates of different mineral substances: and the third is devoted to the consideration of volcanic products.

The system of Brougniart includes substances which are not treated of by writers on mineralogy, and is divided into five classes. The first contains those substances, excluding the metals, which are combined with oxygen; it contains two orders: the first including air and water; and the second the acids. The second class treats of saline bodies, and comprehends the alkaline and the earthy salts. The third class, containing stones, includes the hard, the magnesian, and the argillaceous stones. The fourth class contains the combustible substances, *viz.* the compound and simple. The fifth class includes metals, which are separated into the brittle and the ductile.

The system of Werner, as given by Professor Jameson, has been chiefly adhered to in this work, and a detail of the several genera will be found in their alphabetical order; it will therefore be sufficient in this place, to give an outline of his system.

He has arranged the characters of minerals under four divisions: the external; the internal or chemical; the physical; and the empirical. To the first belong the characters drawn from those properties which are obvious to the senses, such as colour, lustre, transparency, form, texture, hardness, and specific gravity: to the second, those which are derived from the chemical composition, or discovered by any chemical change which the mineral suffers: to the third are referred those characters which are afforded by certain physical properties, as electricity or magnetism; and to the fourth, a few characters, derived from circumstances frequently observed with regard to a mineral, as the place where it is found, or the minerals by which it is usually accompanied.

Of these divisions, the external characters are considered as the most important, and it is chiefly with regard to them that so much labour has been employed on the language of mineralogy. The first property is colour, which, though but seldom highly characteristic, is one of the most obvious characters. It varies frequently in the same species, and is liable to change by very trivial foreign circumstances; it always enters, however, into the description. To give precise ideas of the different shades of colour, Werner has fixed on certain principal or standard colours, to which the subordinate shades are referred; defining them by means of an epithet, either expressive of the intermixture of one of the principal colours with the other, or derived from some substance familiarly known, the colour of which is constant. The principal characters are white, grey, black, blue, green, yellow, red, and brown. Of these are numerous subordinate colours, as bluish-grey, greyish-black, &c. These are not always well marked, but incline to, are intermediate, or pass into each other. The shade of colour is of different intensities, as dark, deep, light, and pale. Besides these, other varieties are introduced, as dotted, striped, zoned, &c. and the colour is varied by scraping the surface, affording a character called a streak.

Lustre denotes the relation which a fossil bears to the reflection of the light from its surface. According to Werner, "resplendent" denotes the highest degree of lustre, which is such as to be seen at a considerable distance; "shining" is applied when the lustre, though perceived at a distance, is not so well observed as on a near approach; "glistening," when it is perceptible only at a very short distance; "glimmering," when some of the minute parts only of a surface reflect a weak light: and "dull," when lustre is entirely wanting. Different kinds of lustre are also marked, as the metallic, adamantine, vitreous, waxy, pearly, and resinous.

Transparency is denoted by different degrees and terms; "transparent," is applied where objects can be distinctly perceived through the interposed substance; "semi-transparent," where objects are seen, but not distinctly, and this only through thin pieces; "translucent," when light is in some measure transmitted, but objects cannot be observed; "opaque," when no perceptible light is transmitted: connected with transparency is refraction, which, in the greater number of minerals, is single, but in some double, the latter giving a double image when an object is surveyed through them.

Form, the most important, perhaps, of the external characters, includes the figures of their crystals, and the various particular shapes which many of them, even in their uncrystallized state, often assume. The texture of fossils, as discovered by their fracture, affords another and very important discriminating character. The fracture may either present a surface continuous or uninterrupted; or it may present a surface composed of an aggregation of distinct parts, by which the continuity is more or less broken. The former is denominated the compact, the latter has been termed the jointed fracture; and each is subdivided into a number of varieties. Minerals are likewise discriminated by their hardness. The degree of it in a fossil is judged of with most certainty by the comparative facility or difficulty of impressing it. Four degrees of it are marked by Werner; the "hard," in which the substance is not capable of being scratched with the knife, but gives sparks when struck by the steel; "semi-hard," when it does not strike fire with steel, and may be scraped by the knife; "soft," when it may be easily scraped with the knife, but receives no impression from the nail; and "very soft," when it is scratched by the nail.

Hauy determines the degrees of hardness according as one fossil impresses another. In one division those are placed which scratch quartz; the individuals belonging to this are arranged, as much as possible, in the order of their relative hardness, so that, when placed in a column, each will impress those beneath it. The second class are those which will scratch glass; these are arranged in a similar manner. In a third, those which scratch calcareous spar: and in a fourth, those which make no impression upon it.

Tenacity is that property which relates to the cohesion of the integrant particles of solid minerals, which, existing in different degrees, give rise to the distinctions of brittle, malleable, and the intermediate degree of sectile.

The frangibility denotes the facility with which a mineral may be broken. It exists in different degrees, which are marked by the common terms of difficultly frangible, easily frangible, &c. According to the Wernerian system, the specific gravity is thus described: a mineral is said to be "supernatent," which is lighter than water, and will swim upon its surface; it is called "light," when the specific gravity is between 1.0 and 2.0: "rather heavy," when the specific gravity is between 2.0 and 4.0: "heavy," where it varies from 4.0 to 6.0: and "very heavy," when the specific gravity is above 6.0. The better way is that which we have adopted under the several genera, of stating the numbers denoting the real specific gravity as found by the hydrostatic balance. To these external characters are added others of less importance, which are derived from properties peculiar to a few minerals, such as that of adhering to the tongue, soiling the finger, feeling hard or unctuous, giving a particular streak on paper, giving, when struck, a peculiar sound, feeling cold when applied to the tongue, having taste, or emitting some perceptible odour.

With respect to the chemical characters: "fusibility" is generally determined by the action of the blow-pipe, as we can thus operate on a small fragment, and perceive easily the appearances presented on fusion. Some minerals are perfectly fusible by it; others melt with facility; some fuse with intumescence; others decrepitate or exfoliate when urged by the flame, or lose their colour; in some the fusion is partial; sometimes the result is a kind of scoria; in many cases it is a complete vitreous globule, transparent or opaque, and of various colours. These appearances are diversified, by adding to the substances various fluxes, as borax, and the phosphates of soda and ammonia. The action of acids affords another chemical character of fossils, by observing whether they effervesce when touched by the acid, or whether, when a small fragment is immersed in it, it is partially or entirely dissolved; if the solution is fluid or gelatinous; and what appearances it presents from the action of re-agents. Diluted nitric acid is generally used in these trials. To the characters taken from certain physical properties are referred the phosphorescence, electricity, and magnetism of minerals. Phosphorescence is peculiar to some minerals, and is therefore a property well adapted to assist in their discrimination. In some it is excited by attrition, more or less strong; in others, by exposing them to heat. The electrical state, either positive or negative, is excited in some minerals by friction, in others by heat; and iron, in many states of combination, is discovered by its magnetic power. An advantage is sometimes taken of what are denominated empirical characters; of these the most important is that derived from the natural association of minerals; some being found in the same situation, and even blended with each other: while there are others which have never been observed to occur together.

MINES. Gold and silver mines belong to the king by his prerogative. By statute 1 and 5 William, c. 30, and 6, no mine of copper, tin, iron, or lead, shall be deemed a royal mine, notwithstanding gold or silver may be extracted from them in any quantities. But the king may take the ore at a certain rate, except in Devon and Cornwall. Maliciously to set fire to a mine or pit of coal is felony, without benefit of clergy. If there is a lease of land, with open mines, the lessee may work them, but not to open new ones. If the lease is of land and mines, and none are opened, the words necessarily imply a right to open mines. If a man open a mine, he may follow the vein under the land of another; but if the latter opens a pit on his own land, the former cannot pursue the vein.

MINIATURE, a delicate kind of painting, distinguished from all others by the smallness of the figures; its being performed with dots or points, instead of lines; by the faintness of the colouring; its requiring to be viewed very near; and by its being usually done on vellum. See PAINTING.

MINIMUM, in the higher geometry, the least quantity attainable in a given case. See MAXIMUM.

MINING, in military affairs, is the art of blowing up any part of a fortification, building, &c. by gunpowder. The art of mining requires a perfect knowledge both of fortification and geometry; and by these previous helps the engineer may be qualified to ascertain correctly the nature of all manner of heights, depths, breadths, and thicknesses; to judge perfectly of slopes and perpendiculars, whether they be such as are parallel to the horizon, or such as are visual; together with the true levels of all kinds of earth. To which must be added a consummate skill in the quality of rocks, earths, masonry, and sands; the whole accompanied with a thorough knowledge of the strength of all sorts of gunpowder. Mining is become one of the most essential parts of the attack and defence of places; so much artillery is used, that nothing above ground can withstand its effects; the most substantial ramparts and parapets can resist but a short time; the out-works, though numerous, serve only to retard, for a time, the surrender of the place.

MINISTER, a person who preaches, performs religious worship in public, administers the sacraments, &c.

MINISTER *of state*, a person to whom a sovereign prince entrusts the administration of the government.

MINISTER, *foreign*, is a person sent into a foreign country to manage the affairs of his province, or of the state to which he belongs. Of these there are two kinds: those of the first rank are ambassadors and envoys extraordinary, who represent the persons of their sovereigns. The ministers of the second rank are the ordinary residents.

MINIUM, in the arts, red lead and oxide of lead. See Lead.

MINSTREL, in ancient customs, certain persons, who combined the character of poet and musician, and whose profession it was to wander about the countries they inhabited, singing panegyrical songs and verses on their occasional benefactors, accompanying them with some musical instrument.

MINT, the place in which the king's money is coined. See Coining.

There were anciently mints in almost every county in England; but the only mint at present in the British dominions is that in the Tower of London. The officers of the mint are, The warden of the mint, who is chief: he oversees the other officers and receives the bullion. 2. The master-worker, who receives the bullion from the warden, causes it to be melted, delivers it to the moneyers, and when it is coined receives it again. 3. The comptroller, who is the overseer of all the inferior officers, and sees that all the money is made to the just size. 4. The assay-master, who weighs the gold and silver, and sees that it is according to the standard. 5. The auditor, who takes the accounts. 6. The surveyor of the melting, who, after the assay-master has made trial of the bullion, sees that it is cast out, and not altered after it is delivered to the melter. 7. The engraver, who engraves the stamps and dies for the coinage of the money. 8. The clerk of the irons, who sees that the irons are clean and fit to work with. 9. The melter, who melts the bullion before it is coined. 10. The provost of the mint, who provides for and oversees all the moneyers. 11. The blanchers who anneal and cleanse the money. 12. The moneyers, some of whom forge the money some shear it, some round and mill it, and some stamp or coin it. 13. The porters, who keep the gate of the mint.

MINUARTIA, in botany, so named from Minuartus, restorer of botany in Spain; a genus of the Triandria Trigynia class and order. Natural order of Caryophyllei. Essential character; calyx five-leaved; corolla none; capsule one-celled, three-valved. There are three species: these are all annual plants, natives of Spain: leaves opposite, clustered; flowers in clusters, having five or three very small petals like glands.

MINUET, in music, a movement of three crotchets or three quavers in a bar, of a slow and graceful motion, and always beginning with the beating note. This is dancing the minuet; but there are others of a time somewhat quicker, and which were formerly used as concluding movements of overtures, sonatas, &c.

MINUTE, in geometry, the sixtieth part of a degree of a circle. Minutes are denoted by one acute accent, thus ('); as, the second, or sixtieth part of a minute, is by two such accents, thus (''); and the third by three ('''), &c.

Minute, in architecture, usually denotes the sixtieth, sometimes the thirtieth, part of a module.

Minute, is also used for a short memoir or sketch of a thing taken in writing.

MIRABILIS, in botany, *marvel of Peru*, a genus of the Pentandria Monogynia class and order. Natural order of Nyctagines, Jussieu. Essential character: calyx inferior; corolla funnel-form, superior; nectary globular, inclosing the germ. There are four species, having tuberous roots and herbaceous stems, which are round, and often trichotomous; leaves opposite; flowers terminating in a sort of corymb; outer calyx bell shaped, spreading; inner large, petaloid, funnel-form, ventricose at the base, dilated above with a spreading border; germ half-covered with an ambient gland; stamens inserted into the gland, and glued to the calycine tube; seed globular, covered with the coriaceous base of the inner calyx. This genus is allied to the Amaranthi and Caryophyllei by its farinaceous seed; to the Dipsaceæ in its habit and double calyx; it differs however, in many marks, and it is difficult to assign it a place; hence Linnæus left it among the plants of doubtful rank, in his "Ordines Naturales."

MIRACLE, is defined by Dr. Samuel Clark to be a work effected in a manner different from the common and regular method of Providence, by the interposition either of God himself, or some intelligent agent superior to man. It has been much controverted, whether true miracles can be worked by any less power than the immediate power of God: and whether, to complete the evidence of a miracle, the nature of the doctrine pretended to be proved by it is necessary to be taken into consideration. The above learned author undertakes to set this matter in a clear light, as follows.

In respect to the power of God, and the nature of the things themselves, all things that are possible at all, are equally easy to be done: it is at least as great an act of power to cause the sun to move at all, as to cause it at any time to stand still; yet this latter we call a miracle, the former not. What degrees of power God may reasonably be supposed to have communicated to created beings, or subordinate intelligences, is imposible for us to determine: therefore a miracle is not rightly defined to be such an effect, as could not have been produced by any less power than the divine omnipotence. There is no instance of any miracle in Scripture, which, to an ordinary spectator, would necessarily imply the immediate operation of original, absolute, and underived power. All things that are done in the world, are done either immediately by God himself, or by created intelligent beings, matter not being at all capable of any laws or powers whatsoever; so that all those things, which we say are the effects of the natural powers of matter and laws of motion, are properly the effects of God, acting upon matter continually and every moment, either immediately by himself, or mediately by some created intelligent beings. Consequently, it is no more against the course of nature for an angel to keep a man from sinking in the water, that for a man to hold a stone from falling in the air, by overpowering the law of gravitation; and yet the one is a miracle, and the other not so.

Mr. Hugh Farmer, who has entered more fully and more successfully into this subject than any other writer, objects to all the definitions of miracles which represent them as effects unusual, above human power, and manifesting the interposition of superior power; because, he says, the term unusual does not distinguish real miracles from many things which are not miraculous, such as the rare and uncommon appearances of nature: nor does the calling a miracle an effect above human power distinguish it from all other effects equally above human power, produced by superior beings, when acting within their usual sphere, which, for that reason, cannot be miraculous. Besides, as this definition comprehends many things which are not miraculous, and to which no persons apply the term, so it excludes many things which are allowed by all to be proper miracles. For there seems to be a difference between effects above human power, or which argue a higher degree of power; and effects which argue a power barely different from human, and in no manner superior to it. According to this definition, beasts and birds may work miracles; for they do many things that are above the power of man. Moreover, this definition, instead of describing miracles by the nature of the works themselves, describes them by their author, and the degree of power necessary to their performance. To which it may be added, that works, which argue only a power more than human, can be no absolute proofs of a divine interposition: and further, the last part of the definition, manifesting the interposition of superior power, is superfluous; because it is only saying, effects above human power must be produced by a power above it.

This writer considers the contrariety or conformity of the event itself to those laws by which the world is governed, in the course of God's general providence, as the only circumstance which denominates and constitutes it a proper miracle, or not; and, therefore, before we can pronounce with certainty any effect to be a true miracle, it is necessary (and nothing more is necessary than) that the common course of nature be in some degree first understood. Miracles, in this view, are not impossible to the power of God, nor necessarily repugnant to our ideas of his wisdom and immutability. Neither do they imply any inconsistency in the divine conduct, or a defect or disturbance of the laws of nature: so that in the general idea of miracles, considered as variations from the common course of nature, there is nothing that can furnish a certain universal proof against their existence; and there is a power superior to nature, which is ever able, and which, in certain circumstances, may reasonably over-rule what was at first established.

The writer, now cited, further maintains, that miracles are neither the effects of natural causes, nor of superior created intelligences, acting from themselves alone: but that they are always to be ascribed to a divine interposition; *i. e.* that they are never wrought, but either immediately by God himself, or by such other beings as he commissions and empowers to perform them. In proof of this proposition, he alleges that the same arguments, which prove the existence of superior created intelligences, do much more strongly conclude against their acting out of their proper sphere. Further, the supposition of the power of any created agents to work miracles of themselves, in this lower world, is contradicted by the observation and experience of all ages; there being, in fact, no proper evidence of the truth of any miracles, but such as may be fitly ascribed to the Deity. Moreover, the laws of nature being ordained by God, and essential to the order and happiness of the world, it is impossible God should delegate to any of his creatures a power of working miracles, by which those divine establishments may be superseded and controlled. Besides, the ascribing to any superior beings, God excepted, and those immediately commissioned by him, the power of working miracles, subverts the foundation of natural piety, and is a fruitful source of idolatry and superstition.

It is further urged, that if miracles were performed in favour of false doctrines, mankind would be exposed to frequent and unavoidable delusion: and if they may be performed without a divine permission, and in support of falsehood, they cannot be credentials of a divine mission, and criterions of truth. So that, upon the whole, if superior beings really possess the miraculous powers which some writers have ascribed to them, the exercise of those powers, by good and evil agents, would either expose mankind to necessary and invincible error, or entirely destroy the credit and use of miracles, under the idea of criterions of truth and authentic credentials of a divine mission. If we appeal to the evidence of revelation on this subject, we shall find, that the view which the Scripture gives us of good angels, of the devil and his angels, as also of the souls of departed men, is inconsistent with their liberty of working miracles; and the view which the sacred writers give us of the gods of paganism, is also absolutely inconsistent with their possessing a power of working miracles. Nevertheless, it has been much disputed, how far it may be in the power of the devil to work miracles? or wherein the specific difference lies between the miracles of Moses, and those of Pharaoh's magicians? those of Jesus Christ and the apostles, and those of Simon Magus and Apollonius Tyaneus? Whether the latter were any more than mere delusions of the senses; or whether any supernatural and diabolical power concurred with them. The author already referred to has considered the subject in all its bearings, and has shown that the magicians, diviners, and sorcerers of antiquity, who pretended, by the assistance of the heathen deities, &c. to foretell future events, or to work miracles, are branded in scripture as mere impostors, incapable of supporting their pretensions by any works or predictions beyond human power or skill.

The Scripture likewise reproaches the pretences to inspiration and miracles, made by false prophets, in support of error and idolatry, as the sole effects of human craft and imposture. And, therefore, since angels, whether good or evil, the spirits of departed men, the heathen deities, magicians, and false prophets, are the only agents who have ever been conceived as capable of working miracles, either in opposition to God, or without an immediate commission from him; and the Scripture denies to all these the power of performing any miracles; it does in effect deny, that any single miracle has ever been performed without the immediate interposition of God. It is likewise alleged, that the Scriptures represent the one true God as the sole Creator and Sovereign of the world, which he governs by fixed and invariable laws; that to him they appropriate all miracles, and that they urge them as demonstrations of his divinity and sole dominion over nature, in opposition to the claims of all other superior beings. The Scriptures also uniformly represent all miracles as being, in themselves, an absolute demonstration of the mission and doctrine of the prophets, at whose instance they are performed; and never direct us to regard their doctrines as a test of the miracles being the effect of divine interposition. Accordingly, the miracles of Christ, in particular, were a demonstration (not a partial and conditional, but a complete and absolute demonstration) of his mission from God: and they were further designed to evince his peculiar character as the Messiah, or anointed; *i. e.* his regal commission and power, or his right by divine designation to dominion and judicature over mankind. And it may be observed, with respect to all the miracles of the New Testament, that their divinity, considered in themselves, is always either expressly asserted, or manifestly implied: and they are accordingly urged as a decisive and absolute proof of the divinity of the doctrine and testimony of their performers, without ever taking into consideration the nature of the doctrine, or of the testimony to be confirmed. It is also shown, that the Scriptures have not recorded any instances of real miracles performed by the devil; in answer to the objections drawn from the case of the magicians in Egypt, from the appearance of Samuel, after his decease, to Saul, which was either the work of human imposture or a divine miracle, and from our Saviour's temptation in the wilderness, which the writer, to whom we now refer, considers as a divine vision.

Miracles, considered as the peculiar works of God, afford a divine testimony to the person on whose account they are wrought, and to that doctrine or message which he delivers in the name of God. And this proof, from miracles, of the divine commission and doctrine of a prophet, is in itself decisive and absolute. It is also the most natural and agreeable to the common sense of mankind in all ages. It is the most easy and compendious proof of a new revelation. Miracles are further a very powerful method of conviction, making a strong impression upon the heart, at the same time that they carry light to the understanding. Nor is the necessity of miracles less evident than their propriety and advantage, in attesting a divine commission and propagating a new revelation. They also serve to revive and confirm the principles of natural religion, and to recover men from those two opposite extremes of atheism and idolatry. Finally, the evidence of miracles, whether of power or knowledge, is the fittest to accompany a standing revelation; because it is not confined to one age or nation, but may be extended over the whole globe, and conveyed to the most distant generations.

MIRROUR, in catoptrics, any polished body impervious to the rays of light, and which reflects them equally

Mirrours were anciently made of metal: but at present they are generally smooth plates of glass, tinned or quicksilvered on the back part, and called looking-glasses. The doctrine of mirrours depends wholly on that fundamental law, that the angle of reflection is always equal to the angle of incidence. See Optics.

Parallel rays falling directly on a plane speculum are reflected back upon themselves; if they fall obliquely, they are reflected in the same angle and parallel as they fell. Hence there is no such thing, properly speaking, as a focus belonging to a plane speculum, neither real nor virtual. The focus of parallel rays is called the solar focus; because in that the image of the sun is formed, and of all objects very remote. But the focus of any object, situated near the mirrour, will have its distance from the vertex more or less than half the radius; the rule in all cases being as follows: "Multiply the distance of the object into the radius of the mirrour, and divide the product by the sum of the radius, and twice the distance of the object; the quotient will be the focal distance of a convex mirrour."

Again, for a concave mirrour, the same product of the radius into the distance of the object, divided by the difference of radius and twice the distance of the object, will give the focal distance. And here we are to observe, that as twice the distance of the object is lesser or greater than the radius, so the focus will be positive or negative, that is, behind the glass or before it.

The image of the object is formed in the focus proper to its distance, and, since the writers on optics demonstrate, that the angles under which the object and its image are seen from the centre or vertex of the mirrour are always equal, it follows, that the image will be always in proportion to the object as the focal distance to the object's distance. The position of the object will be always erect at a positive focus, or behind the speculum diminished by a convex, and magnified by a concave one. Hence, since a convex has but one, *viz.* an affirmative focus; so it can never magnify any object, however posited before it.

The position of the image in a negative focus, or that before the glass, will be ever inverted; and, if nearer the vertex than the centre, it will be less; if further from it, it will be greater than the object: but in the centre it will be equal to the object and seem to touch it.

The image formed by a plane speculum is erect, large as the life, at the same apparent distance behind the glass as the object is before it, and on the same side of the glass with the object. Those properties render this sort of mirrour of most common use, *viz.* as a looking-glass.

If the rays fall directly, or nearly so, on a plane mirrour, and the object be opaque, there will be but one single image formed, or at least be visible, and that by the second surface of the speculum, and not by the first, through which the rays do most of them pass.

But if the object be luminous, and the rays fall very obliquely on the speculum, there will be more than one image formed to an eye placed in a proper position to view them. The first image, being formed by the first surface, will not be so bright as the second, which is formed by the second surface. The third, fourth, &c. images are produced by several reflections of the rays between the two surfaces of the speculum; and, since some light is lost by each reflection, the images from the second will appear still more faint and obscure to the eighth, ninth, or tenth, which can scarcely be discerned at all.

Mirrours may be divided into plane, concave, convex, cylindrical, conical, parabolical, and elliptical.

The properties of cylindrical mirrours are, 1. The dimensions of objects corresponding lengthwise to the mirrour are not much changed, but those corresponding breadthwise have their figures altered, and their dimensions lessened, the further from the mirrour; whence arises a very great distortion. 2. If the plane of the reflection cut the cylindric mirrour through the axis, the reflection is performed in the same manner as in a plane mirrour; and if parallel to the base, the reflection is the same as in a spherical mirrour; if it cut it obliquely, the reflection is the same as in an elliptic mirrour. Hence, as the plane of reflection never passes through the axis of the mirrour, except when the eye and objective line are in the same plane; nor parallel to the base, except when the radiant point and the eye are at the same height; the reflection is therefore usually the same as in an elliptic one. 3. If a hollow cylindric mirrour be directly opposed to the sun, instead of a focus of a point, the rays will be reflected into a lucid line parallel to its axis, at a distance somewhat less than a fourth of its diameter. Hence arises a method of drawing anamorphoses, that is, wild deformed figures on a plane, which appear well proportioned when viewed in a cylindric mirrour.

In an elliptic mirrour, if a ray strike on it from one of its focuses, it is reflected into the other. Parabolic mirrours, as all the rays they reflect meet in one point, make the best burning-glasses.

MISCELLANEÆ, in botany, the name of the fifty-fourth order of Linnæus's "Fragments of a Natural Method," consisting of plants, which, not being connected together by numerous relations, in their habit and structure, as the natural families, are assembled into one head, under the general title of miscellaneous plants.

MISCHIEF. Malicious mischief is an injury of such a gross nature to personal property, that, although it is not done with a felonious intention, or an intent to steal, the law has inflicted punishment upon it by various statutes. Of these are, statute 22 Henry VII. c. 11. against destroying dikes and bridges in the fens of Norfolk, &c. Statute 43 Elizabeth, c. 13, setting fire to stacks of corn, &c. and imprisoning persons on the borders, for the purpose of obtaining ransom. By 22 and 23 Charles II. c. 7. killing horses or cattle is felony; and maiming sheep, &c. a trespass, punishable with treble damages. By statute 1 Anne, s. 2. c. 9. captains and mariners setting fire to ships is felony; and also making a hole in a ship in distress, &c. is felony, and death by statute 12 Anne, s. 12. c. 18. By statute 6 George I. c. 23, the wilfully and maliciously tearing, cutting, spoiling, or defacing the garments of any person passing in the streets or highways, and assaulting, with intent to do so, is felony. And there are other acts which relate to the prevention of setting fire to out-houses with corn, damaging fish-ponds, trees planted in gardens, cutting down sea-banks, hop-binds, setting fire to mines, preventing persons from buying corn, setting fire to goss, furze, &c.; wilfully burning engines in mines, fences in inclosures, breaking into houses of the Plate Glass Company, with intent to destroy utensils; breaking into houses to cut or destroy cloth, serge, linen, &c. in the loom, and other similar offences.

MISCHNAH, or MISNAH, the code or collection of the civil law of the Jews. The Jews pretend that when God gave the written law to Moses, he gave him also another not written, which was preserved by tradition among the doctors of the synagogue, till Rabbi Judah, surnamed the Holy, seeing the danger they were in, through their dispersion, of departing from the traditions of their fathers, judged it proper to reduce them to writing.

The misnah is divided into six parts: the first relates to the distinction of seeds in a field, to trees, fruits, tythes, &c. The second regulates the manner of observing festivals: the third treats of women, and matrimonial cases: the fourth of losses in trade, &c.; the fifth is on obligations, sacrifices, &c.; and the sixth treats of the several sorts of purification.

MISDEMESNOR, or MISDEMEANOUR, a crime less than felony. The term comprehends all indictable offences which are less than felony, as perjury, libels, conspiracies, assaults, &c.

MISNOMER, the using of one name for another. Where a person is described so that he may not be certainly distinguished and known from other persons; the omission, or in some cases, the mistake of the name shall not avoid the grant. But in actions and indictments, &c. the misnomer may be pleaded, and will abate the suit or indictment. But the omission of a letter or so is not material, if the word sounds the same; and courts of law properly discourage the plea.

MISPICKLE, a name given by mineralogists to a native alloy of iron and arsenic. This alloy may be made by fusion; it is white and brittle, and may be crystallized. Iron is capable of combining with more than its own weight of arsenic.

MISPRISION, a neglect, oversight, or contempt. It is chiefly applied to misprision of treason, which is a negligence in not revealing treason, or felony, to a magistrate, where a person knows it to be committed. It is also applied to great misdemeanours. It is, therefore, negative or positive, as it is an act or a concealment of crime. To avoid misprision of treason, the party must make full discovery to a magistrate, and not merely to a private person. To counterfeit foreign coin, not current here, is misprision of treason. A misprision of felony may be by concealing it, or by taking back again a man's goods which have been stolen, which is now made felony. Concealing treasure trove falls under this head. In the class of positive misprisions, or high misdemeanours, are the mal-administration of high officers, and embezzling public money. Contempts against the king's authority, some of which incur a præmunire; contempts against the king's palace or courts. In the palace, if blood be drawn in a malicious assault, it is punishable by perpetual imprisonment, fine, and loss of the offender's right hand, 33 Henry VIII. c. 12. And striking, whether blood is drawn or not, in the king's superior courts, or at the assizes, is punishable with equal or greater severity. A rescue of a prisoner in such a court is punished with perpetual imprisonment, and forfeiture of goods, and the profit of lands during life.

Of a less degree, are reckoned also the injurious treatment of those who are under the immediate protection of a court of justice, the dissuading a witness from giving evidence, and the disclosing, by a grand jury, to the person indicted, of the evidence against him.

MISSIONARIES, such ecclesiastics as are sent by any Christian Church into Pagan or Infidel countries, to convert the natives, and establish the Christian religion among them.

MISSIVE, something sent to another, as missive letters; meaning letters sent from one to another upon business, in contra-distinction to letters of gallantry, points of learning, dispatches, &c.

MITCHELLA, in botany, so named from John Mitchell, M. D. a physician, in Virginia, a genus of the Tetrandria Monogynia class and order. Natural order of Aggregatæ. Rubiaceæ, Jussieu. Essential character: corollas one-petalled, superior, two on the same germ; stigmas four; berry bifid, four-seeded. There is only one species, *viz.* M. repens, creeping Mitchella, which is a native of Carolina, Maryland, and Virginia.

MITELLA, in botany, a genus of the Decandria Digynia class and order. Natural order of Succulentæ. Saxifragæ, Jussieu. Essential character: calyx five-cleft; corolla five-petalled, inserted into the calyx; petals pinnatified; capsule one-celled, two-valved; valves equal. There are two species, *viz.* M. diphylla, two-leaved Mitella; and M. nuda, naked Mitella, natives of North America, and the northern parts of Asia.

MITHRIDATEA, in botany, so named in memory of Mithridates, King of Pontus, a genus of the Monandria Monogynia class and order. Natural order of Scabridæ. Urticæ, Jussieu. Essential character: calyx common, four-cleft, enlarged, fleshy, containing the seeds; corolla none; fruit globular, depressed: seeds solitary, arilled. There is only one species, *viz.* M. quadrifida, a milky tree, with sub-opposite, entire, ever-green leaves; flowers in racemes, seldom solitary, growing on the trunk and lower branches: females fewer, mixed with the males; fruit fleshy, the size of an apple. Native of the islands of Madagascar, Mauritius, and Bourbon.

MITRE, a sacerdotal ornament worn on the head by bishops and certain abbots on solemn occasions; being a sort of cap, pointed and cleft at top. The high-priest among the Jews wore a mitre or bonnet on his head. The inferior priests among the Jews had likewise their mitres, but in what respect they differed from that of the high-priest is uncertain. Some contend that the ancient bishops wore mitres, but this is by no means certain. Those young women among the primitive Christians who professed a state of virginity, and were solemnly consecrated thereto, wore a purple and golden mitre as a badge of distinction. His holiness the pope has no less than four different mitres, which are more or less rich, according to the solemnities of the festivals on which they are worn. The cardinals anciently wore mitres; some canons of cathedrals, in Popish countries, have the privilege of wearing the mitre; and some great families in Germany bear it for their crest.

Mitre, in architecture, is the workman's term for an angle that is just forty-five degrees, or half a right angle. If the angle be half of this, or a quarter of a right angle, they call it half a mitre.

MITTIMUS, a writ by which records are transferred from one court to another. This word is also used for the precept directed to a gaoler, under the hand and seal of a justice of the peace, for the receiving and safe keeping a felon, or other offender, by him committed to gaol.

MIXED *actions*, suits which concern real property, and personal, in as much as they are not only for recovery of land, but also of damages.

MIXT, in mathematics, when applied to an angle or figure, is when any one is comprized by both right or curved lines: applied to a number, it is to one that is partly an integer, and partly a fraction, as $5\frac{1}{4}$. Mixt ratio is when the sum of the antecedent and consequent is compared with the difference of the antecedent and consequent, as if

$$\begin{array}{c} 4 : 3 :: 12 : 9 \\ a : b :: c : d \text{ then,} \\ 7 : 1 :: 21 : 3 \\ a+b : a-b :: c+d : c-d. \end{array}$$

MIXTURE, in chemistry, is distinguished from combination, because in it dissimilar particles are blended together more or less intimately, but without being united by any attraction; in which, therefore, no new qualities are required; in which the difference of parts is easily discovered, and these parts are capable of being separated by mechanical means.

MIZEN, in the sea language, is a particular mast or sail. The mizen mast stands in the sternmost part of the ship. In some great ships there are two of these; when that next the main-mast is called the main-mizen; and that next the poop, the bonaventure mizen. The length of the mizen-mast is, by some, accounted the same with the height of the main-top-mast from the quarter-deck; or half the length of the main-mast, and half as thick. The sail which belongs to the mizen-mast is called the mizen-sail. And when the word mizen is used at sea, it always means the sail. The use of the mizen is to keep the ship close to the wind, or when a ship rides at anchor, to back her a-stern, so that she may not foul her anchor, on the turning of the tide. The term mizen is used in the following phrases: set the mizen, that is, fit the mizen-sail right as it should stand. Change the mizen, or bring the mizen-yard over to the other side of the mast. Peak the mizen, or put the mizen-yard right up and down by the mast. Spell the mizen, or let go the sheet and peak it up.

MNASIUM, in botany, a genus of the Hexandria Monogynia class and order. Natural order of Ensatæ. Junci, Jussieu. Essential character: calyx one-leafed, three-parted, corolla one petalled, three-parted, with a short tube; anthers four-cornered, terminated by an ovate leaflet; germ three lobed; stigmas three, spiral. There is but one species, *viz.* M. paludosum, a perennial plant, found growing in the marshy woods of Guiana.

MNIARUM, in botany, a genus of the Monandria Digynia class and order. Essential character: calyx four-parted, superior; corolla none; seed one. There is but one species, *viz.* M. biflorum: this resembles minuartia so much in its appearance that, without examining the flower, it would be ranked with that genus; it is very smooth, dichotomous, covered all over with approximating, acerose, connate leaves; flowers terminating in pairs, subsessile, generally shorter than the leaves. It is a native of New Zealand and Terra del Fuego.

MNIUM, in botany, a genus of the Cryptogamia Musci class and order. Natural order of Mosses. Generic character: capsule with a lid; calyptre smooth; bristle from a terminating tubercle; male flowers headed, or discoid. Twenty species are enumerated, among which M. hygrometricum is the most remarkable. If the fruit stalk be moistened at the bottom, the head makes three or four turns: and if the head be moistened it turns the contrary way. By some authors this is ranged with the Bryums; and Hedwig makes it a Koelreuteria.

MOAT, or **Ditch**, in fortification, a deep trench dug round the rampart of a fortified place, to prevent surprises.

The brink of the moat, next the rampart, is called the scarpe; and the opposite one, the counterscarpe. A dry moat round a large place, with a strong garrison, is preferable to one full of water: because the passage may be disputed inch by inch, and the besiegers, when lodged in it, are continually exposed to the bombs, granades, and other fireworks, which are thrown incessantly from the rampart into their works. In the middle of dry moats, there is sometimes another small one called cunette, which is generally dug so deep till they find water to fill it. The deepest and broadest moats are accounted the best, but a deep one is preferable to a broad one; the ordinary breadth is about twenty fathoms, and the depth about sixteen.

To drain a moat that is full of water, they dig a trench deeper than the level of the water to let it run off, and then throw hurdles upon the mud and slime, covering them with earth or bundles of rushes, to make a sure and firm passage.

MODE, in philosophy, denotes the manner of a thing's existence, which is two-fold, *viz.* simple or mixed.

Simple modes are only combinations of the same simple idea; thus, by adding units together, indistinct separate collections, we come by all the several modes of numbers, as a dozen, a score, a thousand, &c. Mixed modes, on the contrary, are compounded of simple ideas of different kinds, as beauty, which consists in a certain composition of colour and figure, causing delight in the beholder: such also is theft, which is the concealed change of the possession of a thing, without the consent of the proprietor.

Mode, in music, is defined to be a particular manner of constituting the octave; or, it is the melodious constitution of the octave, as it consists of seven essential sounds, besides the key or fundamental. See Music.

MODEL, in a general sense, an original pattern, proposed for any one to copy or imitate. This word is particularly used in building, for an artificial pattern made in wood, stone, plaster, or other matter, with all its parts and proportions, in order for the better conducting and executing some great work, and to give an idea of the effect it will have in large. In all great buildings it is much the surest way to make a model in relievo, and not to trust to a bare design or draught. There are also models for the building of ships, &c. and for extraordinary stair-cases, &c.

Models are likewise used in painting and sculpture, whence, in the academies, they give the term model to a naked man or woman, disposed in several postures, to give an opportunity to the scholars to design him or her in various views and attitudes.

MODILLIONS, in architecture, ornaments in the cornice of the Ionic, Corinthian, and Composite columns.

The modillions are small inverted consoles, or brackets, under the soffit of the cornice, to support the projection of the plancier. See Architecture.

MODULATION, in music, the art of conducting harmony, in composition, or extemporary performance, through those keys and modes which have a due relation to the fundamental key. Though every piece has its principal or governing key, yet, for the sake of contrast and relief, it is not only allowable, but necessary, to pass from key to key, and from mode to mode: to assume different sharps or flats, and lead the hearer through those transitions of tone and harmony which interest the feelings and delight the ear. See Music.

MODULE, in architecture, a certain measure, taken at pleasure, for regulating the proportions of columns, and the symmetry or disposition of the whole building. Architects generally choose the semi-diameter of the bottom of the column for their module, and this they subdivide into parts or minutes.

MODUS *decimandi*, is a customary tithing different from the common law. It is generally a money compensation which has been taken in lieu of tithes, but the term extends to any mode of altering the usual course of tithing. It must be from time immemorial, and it must be reasonable.

MOEHRINGIA, in botany, so named from Paul Henry Gerard Moehring, a physician, a genus of the Octandria Digynia class and order. Natural order of Caryophellei. Essential character: calyx four-leaved; petals four; capsule one-celled, four-valved. There is but one species, *viz.* M. muscosa, an annual plant, with a slender root; stem filiform, from eight to twelve inches long, upright, much branched; covered with linear, very narrow opposite leaves, dilated at the base; flowers axillary, erect, on slender, one-flowered peduncles; it is a native of the mountains of France, Italy, Switzerland, Austria, and Silesia; among moss on rocks, by the trunks of trees, or little rills of water.

MOHAIR, in commerce, the hair of a kind of goat frequent about Angora, in Turkey; the inhabitants of which city are all employed in the manufacture of camclets made of this hair.

MOINEAU, in fortification is a flat bastion raised between two other bastions, when a re-entering angle before a curtain is too long. The moineau is commonly joined to the curtain, but it is sometimes separated from it by a foss, in which case it is called a detached bastion. The moineau is not raised so high as the works of the place, because it ought to be exposed to the fire of the place, in case the enemy should lodge themselves in it.

MOISTURE, a term sometimes used to denote animal fluids, the juices of plants, or dampness of the air or other bodies.

MOLE. See TALPA.

MOLE *cricket*, the same with gryllo talpa. See GRYLLUS.

MOLE, a massive work of large stones laid in the sea by means of cofferdams: extending before a port, either to defend the harbour from the impetuosity of the waves, or to prevent the passage of ships without leave.

MOLLUGO, in botany, a genus of the Triandria Trigynia class and order. Natural order of Caryophyllei. Essential character: calyx five-leaved; corolla none; capsule three-celled, three-valved. There are six species: these are all annuals, and natives of warm countries.

MOLLUSCA, in natural history, the name of the second order of the Linnæan class Vermes. They are naked; furnished with tentacula, or arms; for the most part inhabitants of the sea; and by their phosphorous quality, illuminate the dark abyss of the waters. This order is comprised of simple animals, furnished with limbs, and distinguished in the following way. A. mouth placed above; of these there are seven genera, *viz.*

Actinia
Ascidia
Clava
Dagysia
Mammaria
Pedicellaria
Salpa

B. mouth placed before: *viz.* the Derris and Pterotrachea.

C. mouth placed before: body with a lateral perforation: of these there are four genera, *viz.*

Doris
Laplysia
Limax
Tethys

D. mouth before: body surrounded with feelers on the fore part; two genera, *viz.* Holothuria and Terebella.

E. mouth before: body furnished with arms: of these there are seven genera, *viz.*

Clio
Lernæa
Lobaria
Onchidium
Scyllæa
Sepia
Triton.

F. mouth before: body furnished with peduncles or feet: of these there are five genera, *viz.*

Amphitrite
Aphrodita
Nais
Nereis
Spio.

G. mouth placed beneath, and generally central. There are five genera, *viz.*

Asterias
Echinus
Lucernaria
Medusa
Physsophora.

MOLOSSES, in commerce, the thick fluid matter remaining after the sugar is made, resembling syrup. See SUGAR.

MOLTING, the change of feathers, hairs, or horns, in birds and beasts.

MOLUCCELLA, in botany, a genus of the Didynamia Gymnospermia class and order. Natural order of Verticillatæ. Labiatæ, Jussieu. Essential character; calyx bell-shaped, widening, broader than the corolla, spiny. There are three species, of which M. spinosa, prickly Molucca baum, has an annual root, with purplish, smooth stems, four feet in height, branching; leaves small, on short footstalks, acutely indented on their edges: calyx, cut into eight segments, each terminated by an acute spine; flowers in whorls. It is a native of the Levant.

MOLYBDATES, in chemistry, salts formed from the molybdic acid and the earths, alkalies, &c. They are mostly colourless, and soluble in water; they have a metallic taste. The prussiate of potash throws down from several of them a light brown coloured precipitate.

MOLYBDENUM is a metal of a greyish white colour, in the form of brittle infusible grains. Formerly two substances were confounded together, which being examined by the industrious and accurate Scheele, he gave to the one the name of Plumbago, which is composed of carbon and iron; the other he called molybdenum. In colour it resembles lead, but in the analysis was obtained sulphur, and a whitish powder, which possesses the properties of an acid. This, Bergman suspected to be a metallic oxide, which has since been demonstrated to be the case. Hitherto this metal is only obtained in grains, the greatest heat has not been sufficient to melt it into a button; its specific gravity is 7.4. When exposed to heat in an open vessel, it gradually combines with oxygen, and is converted into a white oxide, which is volatilized in small brilliant needle form crystals. This oxide, having the properties of an acid, is called the molybdic acid.

Molybdenum is capable of combining with four different proportions of oxygen, and of forming four oxides, the black, the blue, the green, and the yellow or white. To the green is given the name of molybdous acid. It combines readily with sulphur, and in that state it is called molybdena, the sulphuret of molybdenum. This may be formed by distilling together one part of molybdic acid and five parts of sulphur. It will also combine with phosphorus. Muriatic acid has but little effect on the metal; but it dissolves the oxide. Molybdenum will unite with many of the metals, forming with them alloys.

Molybdena, or sulphuret of molybdedum, occurs massive, disseminated, and rarely crystallized. Its colour is like that of fresh cut metallic lead. It occurs in granular distinct concretions; it is opaque, stains the fingers, leaves shining traces when drawn over paper; it is very soft, and easily divisible in the direction of its laminæ. Specific gravity 4.5 to 4.7. It is infusible before the blow-pipe, but exhales a sulphureous odour; at a very high heat it melts, gives out white fumes, and burns with a blue flame: it consists of

Molybdic acid - - - -	45
Sulphur - - - - - -	55
	100

It is found in Norway, Sweden, Saxony, and in Mount-Blanc in Switzerland.

MOLYBDIC
MOLYBDOUS } *acid*. See above. Molybdic acid combines with alkalies, earths, and several metallic oxides, and forms Molybdates, which see. This acid, combined with potash, forms a colourless salt: mixed with filings of tin and muriatic acid, it becomes blue, and precipitates flakes of the same colour, which disappear after some time. It is composed of

Molybdenum - - - - -	67
Oxygen - - - - - - -	33
	100

MOMENT, in the doctrine of time, an instant, or the most minute and indivisible part of duration. Strictly speaking, however, a moment ought not to be considered as any part of time, but only as the termination or limit thereof.

Moment, in the doctrine of infinites, denotes the same with infinitesimal. See Infinitesimal.

MOMENTUM, in mechanics, signifies the same with impetus, or the quantity of motion in a moving body; which is always equal to the quantity of matter multiplied into the velocity; or, which is the same thing, it may be considered as a rectangle under the quantity of matter and velocity.

If b denote a body, and v the velocity of its motion, then $b\,v$ will express or be proportional to its momentum m; again, if B be another body, and v its velocity, then M is $= B\,V$ and $M : m :: B\,V : b\,v$.

MOMORDICA, in botany, a genus of the Monoecia Syngenesia class and order. Natural order of Cucurbitaceæ, Linnæus and Jussieu. Essential character: calyx five-cleft; corolla, five-parted; male filaments three: female, style trifid: pome opening elastically. There are eight species, the most remarkable of which is the M. balsamina, common mordica, or male balsam apple: this has trailing stems like those of the cucumber and melon, extending three or four feet in length, sending out many side branches, which have tendrils; leaves shaped like those of the vine, smooth, deeply cut into several segments; it is a native of India. This plant is famous in Syria for curing wounds; the inhabitants cut open the unripe fruit, and then infuse it in sweet oil, exposed to the sun for some days, until the oil is become red. It is applied to a fresh wound dropped on cotton; the Syrians esteem this next to balsam of Mecca.

MOMOTUS, the *motmot*, in natural history, a genus of birds of the order Picæ. Generic character; bill strong, slightly curved and serrated at the edges; nostrils feathered at the edges; tail wedge-formed. M. brasilienses, or the Brasilian motmot, is the only known species belonging to this genus, and is about eighteen inches long, and nearly of the size of a magpie. It is seen almost always alone, and on the ground, on which it makes its nest, in a hole deserted by some of the smaller quadrupeds. It lives principally upon insects, and abounds in the close woods of Brasil, Cayenne, and Mexico. It is not valued either for its flesh or song.

MONADELPHIA, in botany, *a single brotherhood:* the name of the sixteenth class in Linnæus's system, consisting of plants with hermaphrodite flowers, in which all the stamina, or male organs of generation, are united below into one body or cylinder, through which the pointal passes. The principal characters are, a permanent flower-cup, generally double; five heart-shaped petals, closely embracing one another above; the anthers, kidney-shaped; the receptacle of the fructification prominent, in the middle of the flower; seeds kidney-shaped.

MONANDRIA, in botany, the name of the first class in Linnæus's Sexual system, consisting of plants with hermaphrodite flowers, which have only one stamen or male organ. This class is subdivided, like the other plain classes in the same system, from the number of the styles, or female organs, into two orders, *viz.* those that have one style, and those that have two.

MONARCHY, a government, in which the supreme power is invested in a single person. There are several kinds of monarchies, as where the monarch is invested with an absolute power, and is accountable to none but God. It is an error to suppose, that a despotic or absolute monarch is a solecism in politics, and that there can be none such legally; for the contrary is true, and that in different parts of the world, and from various principles. In China it is founded on paternal authority, and is the basis of the government; in Turkey, Persia, Barbary, and India, it is the effect of religion; and in Denmark, the king is legally absolute, by the solemn surrender which the people made to his predecessor of their liberties. Another kind of monarchy is, that which is limited, where the supreme power is virtually in the laws, though the majesty of government and administration is vested in a single person. Monarchies are also either hereditary, where the regal power descends immediately from the possessor to the next heir by blood; or elective, where the choice depends upon all who enjoy the benefit of freedom, or upon a few persons in whom the constitution vests the power of election. The dangers of monarchy are, tyranny, into which it is liable to degenerate; expense; exaction; military domination; unnecessary wars, waged to gratify the passions of an individual; risk of the character of the reigning prince; ignorance in the governors of the interests and accommodation of the people, and a consequent deficiency of salutary regulations; want of constancy and uniformity in the rules of government; and, proceeding from thence, insecurity of person and property. The advantages of this mode of government are, unanimity of council, activity, decision, secrecy, dispatch; the military strength and energy which result from these qualities of government; the exclusion of popular and aristocratical contentions; the preventing, by a known rule of succession, of all competitors for the supreme power; and thereby repressing the hopes, intrigues, and dangerous ambition of aspiring citizens. An hereditary monarchy is allowed to be decidedly better than one that is elective. A crown, says the late learned Dr. Paley, is too splendid a prize to be conferred on merit. The passions or interests of the electors exclude all consideration of the qualities of the competitors. Among the advantages of an hereditary monarchy, we must not forget, that as plans of national improvement and reform are seldom brought to maturity by the exertions of a single reign, a nation cannot attain to the degree of happiness and prosperity to which it is capable of being carried, unless an uniformity of councils, a consistency of public measures and designs, be continued through a succession of ages. The benefit may be expected where the supreme power descends to the same race, and where each prince succeeds in some sort to the aim, pursuits, and disposition of his ancestor, than if the crown, at every change, devolve upon a stranger, whose first care will commonly be to pull down what his predecessor had built, and to substitute systems of administration, which must give way to others of the succeeding sovereign. See Paley's "Principles of Moral and Political Philosophy."

MONARDA, in botany, so named from Nicholas Monarda, a physician of Seville, a genus of the Diandria Monogynia class and order. Natural order of Verticillatæ. Labiatæ, Jussieu. Essential character, corolla irregular; the upper lip linear, involving the filaments; seeds four. There are seven species.

MONAS, in natural history, a genus of insects of the Vermes Infusoria class and order. Worm invisible to the naked eye, most simple, pellucid, resembling a point. There are five species. M. atomus, is found in sea water after it has been kept a long time: body a white point, sometimes oval, with a minute black dot, variable in its position. M. lens, is transparent, with sometimes a greenish margin.

It is found in all water. A round pellucid dot, frequently in masses, without the least vestige of intestines. M. termo, a most minute, simple, gelatinous point, found in most animal and vegetable infusions; of all known animals the most minute and simple, being so extremely delicate and transparent, as often to elude the most highly magnifying powers, blending as it were in the water in which it swims, and, as far as our present knowledge extends, terminating the vast animal chain, of which man is the opposite extreme.

MONASTERY, a convent, or house built for the reception and entertainment of monks, mendicant friars, or nuns, whether it be an abbey, priory, &c.

Monasteries are governed by different rules, according to the different regulations prescribed by their founders. The first regular and perfect monasteries were founded by St. Pachomius, in Egypt: but St. Basil is generally considered as the great father and patriarch of the eastern monks; since in the fourth century he prescribed rules for the government of the monasteries, to which the anachorets and coenobites, and the other ancient fathers of the deserts, submitted: in like manner St. Benedict was stiled the patriarch of the western monks; he appeared in Italy towards the latter end of the fifth century, and published his rule, which was universally received throughout the west. St. Augustine, being sent into England by St. Gregory the pope, in the year 596, to convert the English, he at the same time introduced the monastic state into this kingdom, which made such progress here, that within the space of 200 years there were thirty kings and queens, who preferred the religious habits to their crowns, and founded stately monateries, where they ended their days in solitude and retirement.

MONETIA, in botany, so called in honour of Jean Baptiste Pierre Antoine de Monet, a genus of the Tetrandria Monogynia class and order. Essential character; calyx four-cleft; petals four; berry two-celled; seeds solitary. There is but one species, *viz.* M. barlerioides, four-spined Monetia, a native of the East Indies and the Cape of Good Hope.

MONEY, a substance, commonly metal, and generally of a determined shape and weight, to which public authority has affixed a certain value to serve as a medium in commerce. We may refer our readers to the article Coin for much interesting matter on this subject. See also Medal. Money is usually divided into real or effective, and imaginary, or money of account. See Exchange. Real money includes all coins or species of gold, silver, copper, &c. which exist and have currency, such are guineas, louis-d'ors, pistols, ducats, &c. Imaginary money, or money of account, is that which has never existed, or at least which does not exist in real specie, but is a denomination invented or retained, to facilitate the stating of accounts by keeping them still on a fixed footing, not to be changed like current coins, which the authority of the sovereign raises or lowers according to the exigencies of the state.

Of this kind are pounds in England and its dependencies, for which there never was a coin to answer. In France livres were of that kind; but for the franc of modern France, which answers in value to the livre, there is a corresponding coin. Among the ancients, the Greeks reckoned their monies of account by the drachma, minæ, and talents. The drachma was equal to about 7¾*d.* sterling; of these 100 made a minæ, equal to 3*l.* 4*s.* 7*d.* and 60 minæ made a talent, equal to 193*l.* 15*s.*; hence 100 talents amounted to 19,375*l.* The same denominations were used in other Asiatic nations, but the values were different. Roman monies of account were, the sestertius and the sestertium: the former was worth something less than 2*d.* and 1000 of these, equal the sestertium, was worth 8*l.* 1*s.* 5½*d.* sterling. For the theory of coins, and of money in general, and for a great variety of interesting and important information on these and other topics of political economy connected with them, we refer to a treatise on the coins of the realm by the Earl of Liverpool, and to Mr. Wheatley's Essay on the Theory of Money and the Principles of Commerce.

Money, *bringing into court.* In some actions at law the defendant is allowed to pay a sum into court, which he contends is the fair amount of the plaintiff's just demand, and the plaintiff will afterwards proceed at his peril. This can only be done where the damages can readily be ascertained in money.

MONEYERS, officers of the mint, who work and coin gold and silver money, and answer all waste and charges.

Monkey. See Simia.

MONNIERIA, in botany, so named from Mons. Monnier, of Paris, a genus of the Diadelphia Pentandria class and order. Essential character: calyx five-parted, with the upper segment long; corolla ringent; stamens two, the upper with two anthers, the lower with three; capsules five, one-seeded. There is but one species, *viz* M. trifolia. This is an annual plant, with a dichotomous stem, ternate leaves, and white flowers in a bifid spike. It is a native of America.

MONOCHORD, in music, an ancient instrument, or machine, so called, because it is furnished with only one string. Its use is to measure and adjust the ratios of the intervals, which it effects by the means of moveable bridges, calculated to divide the chord at the pleasure of the performer. The monochord was regarded by the ancients as the only means of forming the ear to the accurate perception, and the voice to the true intonation, of those minute and difficult intervals which were then practised in melody. Lord Stanhope, who has employed much time on the subject of music, has described a new monochord, of which the following is his Lordship's account.

1. The wire is made of steel, which does not keep continually lengthening, like brass or iron. 2. The whole wire forms one straight horizontal line, so that the moveable bridge can be moved without altering the tension of the wire; which is not the case when the wire pulls downwards on the bridges. 3. The ends of the wire are not twisted round the two stout steel pins that keep it stretched; but each end of the wire is soft soldered in a long groove formed in a piece of steel, which goes over its corresponding pin. 4. One of these two steel pins is strongly fastened by a brass slider, which is moved by means of a screw with very fine threads, this screw having a large micrometer head minutely divided on its edge, and a corresponding nonius; whence the tension of the wire may be very exactly adjusted. 5. A slider is fixed across the top of the moveable bridge, and is moved by means of another screw with very fine threads. 6. The slider is adjusted to the steel rod or scale, by means of mechanical contact against projecting pieces of steel firmly fixed on that steel scale, at the respective distances specified in the monochord table. 7. Each bridge carries a metallic finger, which keeps the wire close to the top of such bridge, while the remainder of the wire is made to vibrate. 8. The vibrations of the wire are produced by touching it with a piece of cork with the same elastic force, and always at the distance of one inch from the immoveable bridge. The Stanhope monochord, though very ingeniously constructed, is in some respects thought inferior to the monochord contrived by Mr. Atwood. In this gentleman's apparatus the string hangs vertically, its tension being regulated by a weight suspended at its lower extremity, a little below the place where the string comes into contact with a fixed pulley; the length of the string is terminated at top by a horizontal edge; the other point of termination, which in the common monochords, as well as in many musical instruments, and in the Stanhope monochord, is a bridge over which the string is stretched, is in this construction effected by two steel edges vertically placed, that are capable of approaching, or of receding from, one another, like the cheeks of a vice: these, being fixed on a frame worked by micrometer screws, can be easily moved in the vertical direction, so as to alter the length of the string in any desired proportion: these edges are separated occasionally by a spring in order to let the string pass freely through, when its length is altered, and are closed again, so as to press the string slightly, when that length is properly adjusted. By means of this construction the alteration of the tending force, by the application of bridges, &c. is wholly avoided. The scale placed under the string of this monochord is divided into 100 equal parts, and each of these by a micrometer screw into 1000 equal parts; so that, by the aid of a microscope and a proper index, the length of a given part of the string may be adjusted on the monochord true to the $\frac{1}{100000}$dth part of its whole length.

MONOCULUS, in natural history, a genus of insects of the order Aptera. Legs four to eight, formed for swimming, and very long; body covered with a crest, or shell, divided into segments; antennæ sometimes four, sometimes two, and sometimes without any; four feelers, in continual motion when swimming, the hind ones very small, and hook-shaped. There are about 50 species, separated into sections. A. With a single eye and crustaceous body. B. With a single eye, and bivalve shell; antennæ branched. C. With a single eye, and bivalve shell; antennæ simple. D. With a single eye, and bivalve shell; antennæ tufted at the tip. E. With a single eye, and univalve shell; antennæ two. F. Shell univalve; two eyes placed beneath. G. Shell bivalve; eyes two, placed on the back. The greater part of the Monoculi are very small water insects, requiring the assistance of the microscope for the investigation of their particular organs. To this there is, however, an exception in the M. polyphemus, which inhabits India. This is distinguished by the title of the Molucco crab, or king crab, and grows sometimes to the length of four feet. In this species the eyes, instead of being approximated, as is required in the Linnæan generic character, are extremely distant from each other, being situated towards the sides of the shell. "The whole structure of this animal is very remarkable, and particularly his eyes, which are between the fourth and last pair of claws on each side, reckoning from his mouth, and excluding the small pair there placed, are inserted the rudiments of another pair, or a claw broken off on each side at the second joint or elbow; on these extremities are the eyes like those of the horns of snails; but under the covert of a thick and opaque shell, nature in that place has wonderfully contrived a transparent lantern, through which the light is conveyed." The great American king crab is very like this, but is specifically distinct.

MONODON, the *narwhal*, in natural history, a genus of Mammalia, of the order Cete. Generic character: tooth (sometimes two teeth) in the upper jaw, projecting strait forwards, long and spiral; spiracle on the head. The only species of this genus is M. monoceros, or the unicorn narwhal; this is found in the northern seas, and generally of the length of twenty feet from the mouth to the tail; from a socket in the upper jaw on one side, a tooth somewhat resembling a horn grows, in a perfectly straight direction, and a wreathed or screw-like form, to the length of six, and occasionally nine or ten feet, of a light yellow colour, and terminating in a sharp point, a circumstance by which it is discriminated from every other species of whales. The incipient protrusion of a second tooth on the other side of the jaw is generally perceivable, and in some instances, though rarely, both advance to maturity. The narwhals subsist principally upon flat fish.

They are seldom observed in the open sea, and frequent the unfrozen spots near the coast of the arctic regions, where they seldom fail of their favourite food, and resort in considerable numbers, for the advantage both of certain supplies and convenient respiration. They are taken by the Greenlanders in great abundance by the harpoon; their flesh is eaten prepared in various ways, and the oil and intestines are also articles in great request at the table of these unfastidious people. The tendons are split into thin fibres, serving the purposes of thread, and the teeth are used sometimes for hunting horns, and more frequently as pillars and gate-posts in houses. These horns were formerly considered as indicative of royal state and magnificence, being employed as the ornaments of palaces, of which some traces are yet in existence. Medical virtue was likewise attributed to them of the highest excellence.

MONOECIA, in botany, one of Linnæus's classes of plants, the twenty-first in order; in which the male and female flowers are placed separately on the same plant, or rather on different stalks growing from the same root. The plants in this class are not hermaphrodite; nor male and female upon the different roots; but androgynous; that is, they consist of male and female flowers upon different parts of the same plant. The orders in this class are derived from the number, union, and situation of the stamina, or male organs.

MONOGRAM, a character or cypher, composed of one, two, or more letters, interwoven; being a kind of abbreviation of a name, anciently used as a seal, badge, arms, &c. The use of arms is very ancient, as appears from Plutarch, and from some Greek medals of the time of Philip of Macedon, and Alexander his son. The Roman labarum bore the monogram of Jesus Christ, which consisted of two letters, a P placed perpendicularly through the middle of an X, as we find it on many medals in the time of Constantine, these being the two first letters of the word ΧΡΙΣΤΟΣ. Thus under the eastern empire it is usual to find MIK, which are the monogram of Mary, Jesus, Constanstine.

MONOGYNIA, in botany, the name of the first order or subdivision in the first thirteen classes of the Linnæan system, consisting of plants, which, besides their agreement in the classic character, generally derived from the number of stamina, have only one style or female organ.

MONOTONY, an uniformity of sound, or a fault in pronunciation, when a long series of words are delivered in one unvaried tone.

MONOTROPA, in botany, a genus of the Decandria Monogynia class and order. Essential character: calyx none; petals ten, the five outer hollowed melliferous at the base; capsule five-valved. There are two species, *viz.* M. hypopithys, yellow bird's nest; and M. uniflora; natives of

North America, and many parts of Europe.

MONSONIA, in botany, so named in honour of Lady Ann Monson, a genus of the Monadelphia Dodecandria class and order. Natural order of Gruinales. Gerania, Jussieu. Essential character; calyx five-leaved; corolla five-petalled; stamina fifteen, united into five filaments; style five-cleft: capsule five-grained. There are three species, all natives of the Cape of Good Hope.

MONSOON, in physiology, a species of trade wind, in the East Indies, which for six months blows constantly the same way, and the contrary way the other six months. However, it ought to be observed, that the points of the compass from whence the monsoons blow, as well as the times of their shifting, differ in different parts of the Indian ocean.

The cause of monsoons is this: when the sun approaches the northern tropic, there are countries, as Arabia, Persia, India, &c. which become hotter, and reflect more heat than the seas beyond the equator, which the sun has left; the winds, therefore, instead of blowing from thence to the parts under the equator, blow the contrary way; and, when the sun leaves those countries, and draws near the other tropic, the winds turn about, and blow on the opposite point of the compass. See WIND.

MONTGOLFIER (STEPHEN JAMES), in biography, famous as the inventor of aerostatic balloons, was born at Annonay, thirty-six miles from Lyons, and there carried on an extensive manufacture of paper, in conjunction with his brother Joseph. They were distinguished for their ingenuity in this branch, and were the first in France who made the beautiful vellum paper. It is said, that the incident of covering a coffee-pot, in which water was boiling, with a spherical cap of paper, which rose in the air as the water heated, first gave him the idea of an air balloon. Others affirm, that reflecting on the ascent of smoke and clouds in the atmosphere suggested the hint. However this were, it appears that Stephen, in the middle of November, 1782, made an experiment at Avignon with a bag of fine silk, of the shape of a parallelopipedon, and of forty cubic feet in capacity, to the aperture of which he applied burning paper till it was filled with a kind of cloud, when it ascended rapidly to the ceiling. This experiment was repeated by the two brothers at Annonay, with a success that induced them to form a machine of the capacity of six hundred and fifty cubic feet, which, filled in like manner with smoke, ascended to the height of six hundred feet. They proceeded enlarging the experiment, till they had constructed a globe of linen, lined with paper, of the capacity of twenty-three thousand four hundred and thirty cubic feet, which, inflated with the smoke of straw and chopped wool, rose to an elevation of about six thousand feet. This power of ascent M. Montgolfier attributed not merely to the rarefaction of the air from the heat (which appears to be the true cause), but to a species of gas specifically lighter than common air, supposed to be disengaged from the burning substances. When the event of these experiments was reported at Paris, the philosophers of that capital immediately thought of applying, for the purpose of inflation, a gas which they knew to be eight or ten times lighter than common air, namely, inflammable air, and trials were immediately made upon that principle, which have proved highly successful. In the mean time, Montgolfier continued to extend his plans, and on September 19, 1783, he exhibited before the king and royal family, at Versailles, a grand machine, near sixty feet high, and forty-three in diameter, which ascended with a cage, containing a sheep, a cock, and a duck, and conveyed them through the air in safety to the distance of above ten thousand feet. Emboldened by this success, M. Pilatre de Rozier first offered himself to undertake the hazardous adventure of an aerial navigation, in a new machine of Montgolfier's of still larger dimensions. After first ascending alone to the height of eighty-four feet, he again seated himself in the car with the Marquis d'Arlandes, when they gave all Paris the astonishing spectacle of hovering in the air over that city for about nine minutes, at the height of three hundred and thirty feet. This brilliant experiment caused the annual prize of the Academy of Sciences to be awarded to M. Montgolfier, and from that æra, October 19, 1783, the atmosphere has been a new field of human daring. The first principle of ascent, however, though applied in various succeeding instances, gradually gave way to the safer and more efficacious one of a gaseous fluid permanently lighter than the air. In one unfortunate instance the two modes were combined, and the result was, that the balloon caught fire, and occasioned the death of the first adventurer, Pilatre de Roziert, and his companion Romain. Montgolfier was rewarded for his discovery by admission into the Academy of Sciences, the cordon of St. Michael, and a pension of two thousand livres. He died in 1799.

MONTH, in chronology, the twelfth part of a year.

Time being duration, marked out for certain uses, and measured by the motion of the heavenly bodies, there thence results divers kinds of months as well as years, different from one another according to the particular luminary by whose revolution they are determined, and the particular purposes they are destined for; hence months are of two kinds, astronomical and civil. An astronomical month is that which is governed either by the motion of the sun or moon, and is consequently of two kinds, solar and lunar: a solar month is that time in which the sun seems to run through a whole sign, or the twelfth part of the ecliptic. Hence, if regard be had to the sun's true apparent motion, the solar month will be unequal, since the sun is longer in passing through the winter-signs than through those of the summer; but as he constantly travels through all the twelve signs in 365 days, 5 hours, and 49 minutes, the quantity of a mean month will be had, by dividing that number by 12; on this principle, the quantity of a solar month will be found to be 30 days, 10 hours, 29 minutes, 5 seconds. A lunar month is that space of time which the moon takes up in performing its course through the zodiac, or that measured by the motion of the moon round the earth; and is of three kinds, *viz.* periodical, synodical, and that of illumination. The lunar periodical month, is the space of time wherein the moon makes her round through the zodiac, or wherein she returns to the same point, being 27 days, 7 hours, 43 minutes, and 5 seconds.

The lunar synodical month, called also absolutely the lunar month and lunation, is the space of time between two conjunctions of the moon with the sun; or the time it takes from one conjunction with the sun to the next: or from one new moon to another: the quantity of a synodical month is 29 days, 12 hours, 44 minutes, 3 seconds, and 11 thirds. The quantity of a synodical month is not the same at all times, for in the summer solstice, when the sun seems to move slowest, the synodical month appeareth less, being about 29 days, 6 hours, 42 minutes; but in the winter, when the sun's motion seems faster, the moon does not fetch up the sun so soon, for which reason the synodical month then seems greater, *viz.* 29 days, 19 hours, and 37 minutes, according to the observation of the same astronomers: so that the first quantity given of the synodical month is to be understood as to the mean motion. From what has been said, it may easily appear that the difference between a periodical and synodical month is this; the first is called periodical in respect of the moon's orbit; but the synodical is so called in respect of its connection with the other luminary. Now, after the time of its conjunction, the sun does not continue in the same place of the zodiac, but moves forwards towards the east, upon which it falls out, that the moon, finishing its course, does not find the sun again in the same place where it left him, he being removed almost a whole sign from his former place, so that, to overtake the sun again, it plainly appears that a certain space of time is requisite besides the periodical, which makes up the synodical month.

A civil or political month, consists of a certain number of days, according to the laws and customs of the different countries wherein it is used, either having no regard to the solar or lunar months; as those of the Egyptians in the equal year, of the Romans in the year of Romulus, &c.; or coming pretty near to the solar astronomical month, as the Julian; or else the lunar astronomical, as the Jewish, Turkish, and others. The British, and most European nations, make twelve months in the year, *viz.* January, Februaary, &c. See January, &c.

Civil solar months are such civil months as are accommodated to the astronomical months, or those which are to consist alternately of thirty and thirty-one days, excepting one month of the twelve, which, for every fourth year, consisted of thirty days, and for the other years of twenty-nine. This form of civil months was introduced by Julius Cæsar; but under Augustus, the sixth month, till then, from its place called Sextilis, was denominated Augustus, in honour of that prince; and to make the compliment yet the greater, a day was added to it, so that it now consists of thirty-one days, though till then it had only thirty: to make up for which, a day was taken from February, so that from thenceforward it only consisted of twenty-eight days, and every fourth year of twenty-nine; though before it had ordinarily consisted of twenty-nine days, &c. and such are the civil or calendar months which now obtain throughout Europe.

Civil lunar months are to consist alternately of twenty-nine and thirty days: thus will two civil months be equal to two astronomical ones, abating for the odd minutes, and consequently the new moon will be hereby kept to the first day of each such civil month, for a long time together. However, to make them keep constant pace with the civil months, at the end of each nine hundred and forty-eight months, a month of twenty-nine days must be added; or else every thirty-third month must consist of thirty days. This was the month in civil or common use among the Jews, Greeks, and Romans, till the time of Julius Cæsar.

Month, in law, is generally a lunar month of twenty-eight days, unless otherwise expressed.

MONTIA, in botany, so called in honour of Joseph Monti, a genus of the Triandria Trigynia class and order. Natural order of Pontulaceæ, Jussieu. Essential character: calyx two-leaved; corolla one-petalled; irregular; capsule one-celled, two-valved. There is but one species, *viz.* M. fontana, water chickweed, native of many parts of Europe.

MONTINIA, in botany, so called in memory of Lawrence Montin, a Swedish botanist, a genus of the Dioecia Tetrandria class and order. Natural order of Calycanthemæ. Onagræ, Jussieu. Essential character: calyx four-toothed, superior; petals four. Female filaments barren; style bifid; capsule oblong, two-celled. There is only one species, *viz.* M. acris glaucus, montinia, a native of the Cape of Good Hope.

MONUMENT, in architecture, a building destined to preserve the memory, &c. of the person who raised it, or for whom it was raised; such are, a triumphal arch, a mausoleum, a pyramid, &c. The first monuments that were erected, by the ancients, were of stones, which were laid over tombs, on which were cut the names and actions of the deceased. These stones were distinguished by various names, according as their figures were different: the Greeks called those which were square at the base, and were the same depth throughout their whole length, steles; from whence our square pilasters, or attic columns are derived: those which were round in their base, and ended in a point at top, they called styles; which gave occasion to the invention of diminished columns: those which were square at the foot, and terminated in a point at the top, in the manner of a funeral pile, they called pyramids: to those whose bases were more in length than in breadth, and which rose still lessening to a very great height, resembling the figure of the spits or instruments used by the ancients in roasting the flesh of their sacrifices, they called obelisks.

The monument in London, is a magnificent pillar, erected by order of Parliament, in memory of the burning of the city of London, anno 1666, in the very place where the fire began. This pillar is of stone, of the Doric order, and fluted, being two hundred and two feet high, and the diameter fifteen; it stands on a pedestal forty feet high, and twenty-one feet square, the front being enriched with curious emblems in basso relievo: within are winding stairs, up to the very top.

MOOD, or Mode, in logic, called also syllogistic mood, a proper disposition of the several propositions of a syllogism, in respect of quantity and quality.

As in all the several dispositions of the middle term, the propositions of which a syllogism consists may be either universal or particular, affirmative or negative; the due determination of these, and putting them together as the laws of augmentation require, constitute what logicians call the moods of syllogisms. Of these moods there are a determinate number to every figure, including all the possible ways in which propositions differing in quantity or quality can be combined, according to any disposition of the middle term, in order to arrive at a just conclusion. There are two kinds of moods, the one direct, the other indirect.

The direct mood is that wherein the conclusion is drawn from the premises, directly and immediately, as, "Every animal is a living thing; every man is a living animal; therefore every man is a living thing." There are fourteen of these direct moods, four whereof bolong to the first figure, four to the second, and six to the third. They are denoted by so many artificial words framed for that purpose, *viz.* 1. Barbara, celerent, darii, ferioque. 4. Baralip, celantes, dabitis, fapesmo, frisesom. 2. Cesare, camestres, festino, baroco. 3. Darapsi, selapton, disamis, datisi, bocardo, ferison. The use and effect of which words lie wholly in the syllables, and the letters whereof the syllables consist; each word, for instance, consists of three syllables, denoting the three propositions of a syllogism, *viz.* major, minor, and conclusion: add, that the letters of each syllable are either vowels or consonants; the vowels are A, which denotes an universal affirmative; E, an universal negative; I, a particular affirmative; and O, a particular negative: thus Barbara is a syllogism or mood of the first figure, consisting of three universal affirmative propositions. Baralip, one of the fourth figure, consisting of two universal affirmative premises, and a particular affirmative conclusion. The consonants are chiefly of use in the reduction of syllogisms. The direct mood, is that wherein the conclusion is not inferred immediately from the premises, but follows from them by means of a conversion, as, "Every animal is a living thing; every man is an animal; therefore some living thing is a man."

Mood, or **Mode**, in grammar, the different manner of conjugating verbs, serving to denote the different affections of the mind. See **Grammar**.

MOON, *luna*, ☾, in astronomy, a satellite, or secondary planet, always attendant on our earth.

The moon being the nearest, and, next to the sun, the most remarkable body in our system, and also useful for the division of time, it is no wonder that the ancient astronomers were attentive to discover its motions, and the orbit which it describes.

The motion of the moon in its orbit about the earth is from west to east, and its orbit is found to be inclined to the ecliptic. The motion of the moon is also observed not to be uniform, and its distance from the earth is found to vary, which shews that it does not revolve in a circle about the earth in its centre; but its motion is found to be in an ellipse, having the earth in one of the foci. The position of the ellipse is observed to be continually changing, the major axis not being fixed; but moving sometimes direct and sometimes retrograde: but, upon the whole, the motion is direct, and it makes a complete revolution in a little more than eight years and a half. The eccentricity of the ellipse is also found to change, that is, the ellipse is sometimes nearer to a circle than it is at other times. The inclination of its orbit is found likewise subject to a variation from 5° to 5° 18′. All these irregularities arise from the sun disturbing the moon's motion by its attraction. As the ellipse which the moon describes about the sun is subject to a variation, the periodic time of the moon about the earth will also vary: in winter the moon's orbit is dilated, and the periodic time is increased; and in summer, her orbit is contracted, and her periodic time diminished. The periodic time of the moon increases whilst the sun is moving from his apogee to his perigee, and decreases whilst he moves from his perigee to his apogee; and the greatest difference of the periodic times is found to be about twenty-two minutes and a half. The mean periodic time of the moon is $27^d\ 7^h\ 43'\ 11'', 5$; this is called her sidereal revolution, being the mean time from her leaving any fixed star till her return to it again. Now it is found by observation, that the mean time from her leaving her apogee till she returns to it, is $27^d\ 13^h\ 18'\ 4''$; hence the moon is longer in returning to her apogee than she is in making a revolution in her orbit, and therefore her apogee must move forward. The mean time for her leaving her node till she returns to it again, is $27^d\ 5^h\ 5'\ 35''$, 6, and this being less than her mean periodic time, it follows, that she returns to her node before she has completed her revolution, and therefore her nodes must have a retrograde motion. The time between two mean conjunctions of the sun and moon, or from new moon to new moon, supposing their motions had both been uniform, is found by multiplying the periodic times of the earth and moon together, and dividing by their difference; taking therefore the mean periodic time of the moon and sun as already stated, we get the mean time from conjunction to conjunction to be $29^d\ 12^h\ 44'\ 2''$, 8, and this is called her synodic revolution. The true time from new to new moon will be sometimes greater and sometimes less than this.

The apparent diameter of the moon is found continually to vary; now the apparent diameter of any very distant body varies inversely as its distance. Hence, as the apparent diameter of the moon increases, she must approach the earth; and when it decreases, she must recede from the earth. This variation of her apparent diameter agrees exactly with what ought to be the case, if the moon moved in an ellipse about the earth in one of its foci; we conclude, therefore, that the moon moves in an ellipse about the earth situated in one of its foci, as no other supposition will agree with the observed variation of the moon's diameter. From the variation of the sun's diameter it appears, in like manner, that the earth must revolve in an ellipse about the sun, having the sun in one of the foci. The earth moving in an ellipse about the sun in its focus, the nearer the earth comes to the sun, the more it is attracted by him, and this attraction increases in the same ratio as the square of the distance diminishes; and, on the contrary, it decreases as the square of the distance increases. As therefore the earth approaches the sun all the time it moves from the aphelion to the perihelion, the attraction increases, and conspiring partly with the earth's motion, it accelerates the motion of the earth; and when the earth moves from perihelion to aphelion, the attraction acts partly against the earth's motion, and diminishes its motion. Thus, the velocity of the earth increases whilst it moves from the aphelion to perihelion, and decreases as much whilst it moves from perihelion to aphelion.

As the moon moves in an ellipse about the earth in its focus, she must, in like manner, by the earth's attraction, have her velocity increased from her apogee to perigee, and decreased as much from her perigee to apogee. These are the principal causes of the variation of the velocities of the earth and moon. But as the sun attracts the moon, as well as the earth attracts it, the attraction of the sun will cause another variation of the moon's velocity. Thus the moon being attracted both by the sun and earth, they will cause great irregularities in her motion; and hence it is very difficult to compute the place of the moon. After finding the mean place of the moon, that is, the place where she would have been if her motion had been uniform, it requires not less than twenty corrections, in order to get the true place to a sufficient degree of accuracy. Sir I. Newton was the first person who pointed out the sources of these irregularities; but they are of a nature too difficult to admit of a proper illustration. When we view the moon with a telescope, we find that her surface is very rough with mountains and cavities; this appears from the very jagged boundary of the light and dark parts. Also, certain parts are found to project shadows always opposite to the sun; and when the sun becomes vertical to any of them, they are observed to have no shadow; these therefore must be mountains. Other parts are always dark on that side next the sun, and illuminated on the opposite side; these therefore must be cavities. Hence the appearance of the moon constantly varies, from its altering its situation in respect to the sun.

The tops of the mountains on the dark part of the moon are frequently seen enlightened at a distance from the confines of the illuminated part. The dark parts have, by some, been thought seas; and by others, to be only a great number of caverns and pits, the dark sides of which next to the sun would cause those places to appear darker than the rest. The great irregularity of the line bounding the light and dark parts, on every part of the surface, proves that there can be no very large tracts of water, as such a regular surface would necessarily produce a line, terminating the bright part, perfectly free from all irregularity. Also, if there was much water upon its surface, and an atmosphere, as conjectured by some astronomers, the clouds and vapours might easily be discovered by our telescopes; but no such phenomena have ever been observed.

On April 9, 1787, Dr. Herschel discovered three volcanoes in the dark part of the moon; two of them seemed to be almost extinct, but the third showed an actual eruption of fire, or luminous matter, resembling a small piece of burning charcoal covered by a thin coat of white ashes; it had a degree of brightness about it, as strong as that with which such a coal would be seen to glow in faint daylight. The adjacent parts of the volcanic mountain seemed faintly illuminated by the eruption. A similar eruption appeared on May 4, 1783. On March 7, 1794, a few minutes before eight o'clock in the evening, Mr. Wilkins, of Norwich, an eminent architect, observed, with the naked eye, a very bright spot upon the dark part of the moon; it was there when he first looked at the moon, and the whole time he saw it, which was about five minutes; it was a fixed steady light, except the moment before it disappeared, when its brightness increased. The same phenomenon was also observed by Mr. T. Stretton, in St. John's Square, Clerkenwell, London. On April 13, 1793, M. Piazza, astronomer royal at Palermo, observed a bright spot on the dark part of the moon; and several other astronomers have observed the same phenomenon.

It has been a doubt amongst astronomers, whether the moon has any atmosphere; some suspecting that, at an occultation of a fixed star by the moon, the star did not vanish suddenly, but lost its light gradually, and thence concluded that the moon has an atmosphere. M. Schroeter, of Lilianthan, in the Duchy of Bremen, has endeavoured to establish the existence of an atmosphere, from the following observations. 1. He observed the moon, when two days and a half old, in the evening soon after sunset, before the dark part was visible, and continued to observe it till it became visible. Two cusps appeared tapering in a very sharp, faint prolongation, each exhibiting its furthest extremity faintly illuminated by the solar rays, before any part of the dark hemisphere was visible; soon after, the whole dark limb appeared illuminated. This prolongation of the cusps beyond the semicircle, he thinks, must arise from the sun's rays being refracted by the moon's atmosphere. He computes also the height of the atmosphere, which refracts light enough into the dark hemisphere, to produce a twilight, more luminous than the light reflected from the earth when the moon is about 32° from the new, to be 1356 Paris feet, and that the greatest height capable of refracting the solar rays is 5376 feet. 2. At an occultation of Jupiter's satellites, the third disappeared, after having been 1″ or 2 of time indistinct; the fourth became indiscernible near the limb; this was not observed of the other two. See the Philosophical Transactions, 1792.

Many astronomers have given maps of the moon; but the most celebrated are those of Hevelius in his Selenographia; in which he has represented the appearance of the moon in its different states, from the new to the full, and from the full to the new; these figures Mayer prefers. Langrenus and Racciolus denoted the spots upon the surface by the names of philosophers, mathematicians, and other celebrated men; giving the names of the most celebrated characters to the largest spots. Hevelius marked them with the geographical names of places upon the earth. The former distinction is now generally used.

Very nearly the same face of the moon is always turned towards the earth, it being subject to only a small change within certain limits, those spots which lie near the edge appearing and disappearing by turns; this is called its libration. The moon turns about its axis in the same direction in which it revolves in its orbit. Now the angular velocity about its axis is uniform, and it turns about its axis in the same time in which it makes a complete revolution in its orbit; if therefore the angular motion about the earth were also uniform, the same face of the moon would always be turned towards the earth. For if the moon had no rotation on her axis, when she is on opposite sides of the earth, she would shew different faces; but if, after she has made half a revolution in her orbit, she has also turned half round her axis, then the face, which would otherwise have been shewn, will be turned behind, and the same face will appear. And thus, if the moon's angular velocity about her axis were always equal to her angular velocity in her orbit about the earth, the same side of the moon would be always towards the earth. But as the moon's angular velocity about her axis is uniform, and her angular velocity in her orbit is not uniform, their angular velocities cannot continue always equal, and therefore the moon will sometimes show a little more of her eastern parts, and sometimes a little more of her western parts; this is called a libration in longitude. Also, the moon's axis is not perpendicular to the plane of her orbit, and therefore, at opposite points of her orbit, her opposite poles are turned towards the earth; therefore her poles appear, and disappear, by turns; this is called a libration in latitude. Hence, nearly one half of the moon is never visible at the earth, and therefore nearly one half of its inhabitants (if it have any) never saw the earth, and nearly the other half never lose sight of it. Also the time of its rotation about its axis being a month, the length of the lunar days and nights will be about a fortnight each. It is a very extraordinary circumstance, that the time of the moon's revolution about her axis should be equal to that in her orbit.

Sir I. Newton, from the altitude of the tides upon the earth, has computed the altitude of the tides on the moon's surface to be ninety-three feet, and therefore the diameter of the moon, perpendicular to a line joining the earth and moon, is less than the diameter directed to the earth, by one hundred and eighty-six feet. Hence, says he, the same face must always be towards the earth, except a small oscillation; for if the longest diameter should get a little out of that direction, it would be brought in it again by the earth's attraction. The supposition of D. de Mairan is, that the hemisphere of the moon next the earth is more dense than the opposite one; and hence the same face would be kept towards the earth, upon the same principle as before.

When the moon is in conjunction with the sun, she is then said to be new, and her dark side being next to the earth, she is then invisible. As she recedes from the sun, we first discover some of her bright part, and she appears horned till she gets 90° from the sun, when she appears half enlightened, or dichotomised; from thence, till she comes into opposition, she appears above half enlightened, or gibbous; and at opposition she appears full orbed, the same face being then turned towards the earth which is towards the sun, and she is then said to be at her full. And from opposition to conjunction, her apparent bright part decreases as it before increased. When the moon is about three days from the new, the dark part is very visible, by the light reflected from the earth, which is moonlight to the lunaries, considering our earth as a moon to them; and in the most unfavourable state some of the spots may be then seen. But when the moon gets into quadratures, its great light prevents the dark part from being seen. According to Dr. Smith, the strength of moonlight, at the full moon, is ninety thousand times less than the light of the sun; but from experiments made by M. Bouguer, he concluded it to be three hundred thousand times less. The light of the moon, condensed by the best mirrors, produces no sensible effect upon the thermometer.

Our earth, in the course of a month, shews the same phases to the lunaries, as the moon does to us; the earth is at the full at the time of the new moon, and new at the time of the full moon. The surface of the earth being about thirteen times greater than that of the moon, it affords thirteen times more light to the moon than the moon does to us.

Dr. Herschel has measured the height of a great many of the lunar mountains, and finds, that, a few excepted, they generally do not much exceed half a mile. Before he measured them, they were reckoned much higher, being generally over-rated. He observes, that it should be examined whether the mountain stands on level ground, which is necessary, that the measurement may be exact. As the spectator is carried by the earth's rotation, his horizon will continually change its situation, and therefore it will continually cut the moon's orbit, at different points, till it has gone through the whole orbit; and the inclination of the orbit to the horizon will be continually changed. Now the difference between the times of the rising of the moon on two successive nights will depend upon the angle which the moon's orbit makes with the horizon; the less the angle is, the less the moon will have descended below the horizon, at the time when the horizon is brought into the same situation it was twenty-four hours before: therefore, when the angle which the moon's orbit makes with the horizon is the least, there will be the least difference of the times of her rising. Now, that angle is the least when the first point of Aries rises, at which time, in the latitude of London, there is only about seventeen minutes difference of the moon's rising on two successive nights. Now, about the 22d of September, the first point of Aries rises at the time the moon rises, if the moon be then at the full, because it will then be at the beginning of Aries. In this case, therefore, the moon will rise about the full for several nights, with but a small difference of the times of her rising. This happening in the time of harvest, it is called the harvest moon. As the full moon may not happen on the 22d of September, that which happens nearest to it is called the harvest moon. The same small difference of the times of rising of the moon happens every month, but it not happening at the full moon, and at that time of the year, it is not taken notice of. The greatest difference of the times of the moon's rising at London on two successive nights, is about one hour and seventeen minutes; and this happens when the moon is in the first point of Libra, and therefore it happens at the vernal full moons.

There is a phenomenon called the horizontal moon, which is this, that it appears larger in the horizon than in the meridian; whereas, from its being further from us in the former case than in the latter, it subtends a less angle when in the horizon. It is perhaps not easy to give a satisfactory answer to this deception. Gassendus thought, that as the moon was less bright in the horizon than in the meridian, we looked at it, in the former situation, with a greater pupil of the eye, and therefore it appeared larger. But this is not agreeable to the principles of optics, since the magnitude of the image upon the retina of the eye does not depend upon the size of the pupil. Des Cartes thought that the moon appeared largest in the horizon, because, when comparing its distance with the intermediate objects, it appeared then furthest off; and as we judge its distance greater it, that situation, we, of course, think it larger, supposing that it subtends the same angle. Dr. Berkeley accounts for it thus: faintness suggests the idea of greater distance; the moon appearing faintest in the horizon, suggests the idea of greater distance; and, supposing the angle the same, that must suggest the idea of a greater tangible object. He does not suppose the visible extension to be greater, but that the idea of a greater tangible extension is suggested by the alteration of the visible extension. He says, 1. That which suggests the idea of greater magnitude, must be something perceived; for that which is not perceived can produce no effect. 2. It must be something which is variable, because the moon does not always appear of the same magnitude in the horizon. 3. It cannot lie in the intermediate objects, they remaining the same; also, when these objects are excluded from sight, it makes no alteration. 4. It cannot be the visible magnitude, because that is least in the horizon. The cause, therefore, must lie in the visible appearance, which proceeds from the greater paucity of rays coming to the eye producing faintness. Mr. Rowning supposes, that the moon appears furthest from us in the horizon, because the portion of the sky which we see appears not an entire hemisphere, but only a portion of one; and hence we judge the moon to be further from us in the horizon, and therefore larger. Dr. Smith, in his optics, gives the same reason. The same circumstances take place in the sun. Also, if we take two stars near each other in the horizon, and two other stars near the zenith at the same angular distance, the two former will appear at a much greater distance from each other than the two latter. On this account, people are, in general, much deceived in estimating the altitudes of the heavenly bodies above the horizon, judging them to be much greater than they are. The lower part of a rainbow also appears much wider than the upper part; and this may be considered as an argument, that the phenomenon cannot depend entirely upon the greater degree of faintness of the object when in the horizon, because the lower part of the bow frequently appears brighter than the upper part, at the same time that it appears broader. Also, faintness can have no effect upon the angular distance of the stars; and as the difference of the apparent distance of the two stars, whose angular distance is the same in the horizon and the zenith, seems to be fully sufficient to account for the apparent variation of the moon's diameter in these situations, it may be doubtful whether the faintness of the object enters into any part of the cause.

The mean distance of the moon from the earth is about two hundred and thirty-nine thousand miles; and her semi-diameter is nearly three-elevenths of the radius of the earth, or about one thousand and eighty-one miles. And as the magnitudes of the spherical bodies are as the cubes of their radii, the magnitude of the moon: magnitude of the earth $: : 3^3 : 11^3 : : 1 : 49$ nearly. See Vince's Astronomy.

MOORE (Sir Jonas), in biography, an eminent English mathematician in the seventeenth century, was born at Whitlee, in Lancashire, about the year 1620. He enjoyed the advantages of a liberal school education, and afterwards applied himself pirncipally to the study of the mathematics, for which, from his childhood, he had discovered a strong partiality. This favourite pursuit he cultivated with great diligence and success, and acquired such reputation for his proficiency, that during one of the expeditions of King Charles I. into the northern parts of England, he was introduced to his majesty, as a person studious and learned in those sciences. Upon conversing with him, the King expressed much approbation of his acquirements, and gave him a promise of encouragement: which laid the foundation of his future fortune. Afterwards he was appointed mathematical tutor to the King's second son, James, to instruct him in arithmetic, geography, the use of the globes, &c. During Cromwell's government, he appears to have followed the profession of a public teacher of mathematics; for he is stiled in the title-pages of some of his publications, "professor of the mathematics." Mr. Granger says, in his "Biographical History of England," that he was employed by the commissioners for draining and dividing the fens: and in his survey took notice that the sea made a curve line on the beach, from which he took the hint to keep it effectually out of Norfolk. This added much to his reputation; but no mention is made of the period of his life when he was thus occupied. After the restoration of King Charles II. he was noticed and employed by that prince, who bestowed on him the honour of knighthood, and at length promoted him to the important office of surveyor-general of the ordnance. He appears to have been a favourite both with the king and the duke of York, who often consulted him, and followed his advice upon many occasions. To his honour it ought to be recorded, that he frequently availed himself of his interest at court for the advancement of learning, the encouragement of merit, and the establishment of institutions highly favourable and beneficial to the interests of the public, and of science in general. He patronised the famous Mr. Flamstead, who had but a very scanty income at Cambridge when he took him under his protection. In connexion with Sir Christopher Wren, he persuaded the king to erect Flamstead house at Greenwich, for a public observatory, in 1675, recommending Mr. Flamstead to be the king's astronomer, to make observations there; and being surveyor-general of the ordnance himself, this was the reason why the salary of the astronomer-royal was made payable out of the office of ordnance. Being elected a governor of Christ's hospital, he appears to have been instrumental in persuading the king to found the mathematical school there, with the allowance of a handsome salary for a master to instruct a certain number of the boys in mathematics and navigation, to qualify them for the sea service. It ought not to be concealed, that the duke of York also took a zealous and active part in determining his brother to found this useful establishment. This foundation presented Sir Jonas with an opportunity of exerting his abilities in a manner agreeable to his wishes, namely, that of serving the rising generation. And reflecting within himself on the benefit which the nation might receive from a mathematical school, if properly conducted, he made it his utmost care to promote its improvement. In pursuance of his majesty's grant, the school was established; but there was still wanting a methodical institution, from which the youths might receive such necessary helps as their studies required: a laborious work, from which his other great and assiduous employments might very well have exempted him, had not a predominant regard to a more general usefulness determined him to devote all the leisure hours of his declining years to the improvement of such an useful and important seminary of learning. Having thus engaged himself in the prosecution of this generous undertaking, he sketched out a plan or system of mathematics for the use of the school, and afterwards drew up and printed several parts of it himself; but death put an end to his labours, before the work was completed. We are not informed of the year when this event took place; but it could not be long before 1681, when the work was published by his sons-in-law, Mr. Hanway and Mr. Potinger, who spared neither expense nor labour to have it finished in the best manner, and securing proper assistants for that purpose. Besides the New System of the Mathematics, &c. in two volumes, quarto, above mentioned, Sir Jonas published Arithmetic, in two books, viz. Vulgar Arithmetic, and Algebra. To which are added, two Treatises, the one a new Contemplation Geometrical, upon the oval figure called the Ellipsis; the other, the two first Books of Mydorgius, his Conical Sections analyzed, 1660, octavo; A Mathematical Compendium: or, Useful Practices in Arithmetic, Geometry, and Astronomy, Geography, and Navigation, &c. &c. the fourth edition of which is dated in 1705, 12mo.; A General Treatise of Artillery; or Great Ordnance. Written in Italian by Thomas Moretti of Brescia Translated into English, with Notes thereupon, and some Additions out of French for Sea-gunners. By Sir Jonas Moore, Knt. octavo, with the date of 1688.

MOORING, or Moaring in the sea-language, is the laying out the anchors of a ship in a place where she can ride secure. Mooring across, is laying out an anchor on each side; and mooring along, is to have an anchor in a river and a hawser on shore. When ships are laid up in ordinary, or are under orders of fitting for the sea, the moorings are laid out in harbours, and consist of claws, pendent chains, cables, bridles, anchors, swivels, jew's harps, buoys, and chains.

MOOT, a difficult case argued by the young barristers and students at the inns of courts, by way of exercise, the better to qualify them for practice, and to defend the causes of their clients. This, which is called mooting, is the chief exercise of the inns of court. Particular times are appointed for the arguing moot cases; the place where this exercise is performed was anciently called moot-hall; and there is a bailiff, or surveyor of the moots, annually chosen by the bench, to appoint the moot men for the inns of chancery, and to keep an account of the performance of exercises.

MORÆA, in botany, so called in honour of Robert Moore of Shrewsbury, a genus of the Triandria Monogynia class and order. Natural order of Ensatæ. Irides, Jussieu. Essential character: corolla six petalled, the three inner parts spreading narrower: stigma trifid. There are seventeen species. Linnæus remarks, that the flower of Moræa differs from that of Iris, in having all the six petals equally spreading; this being the chief difference, Gærtner is of opinion, that Moræa is too artificial a genus, and might more properly be mixed, partly with Iris, and partly with Ixia.

MORALITY, the science and doctrine of morals, otherwise called ethics. See Philosophy, *moral*

MORAVIANS, Herrnhutters, or Unitas Fratrum, in church history, a denomination of Christians, concerning whose origin, history, and character, various contradictory reports have been published. Crantz divides their history into what he calls ancient and modern. The former refers to them before the time of their settlement in Upper Lusatia, in 1722; the latter after that period. The United Brethren claim the famous Huss, and Jerome of Prague, as their martyrs. M. Crantz, however, places the beginning of the church of the United Brethren in the year 1457, and says, that it arose out of the scattered remains of the followers of Huss. In the year 1450, this people became re-united to the Greek church: but on the taking of Constantinople by the Turks about two years afterwards, that union was again dissolved. After this, various attempts were made to form them into a regularly constituted church, but without success. At length, after many vexations and commotions among themselves, and sundry persecutions from others, they obtained permission to withdraw to a part of the king's domain, on the boundary between Silesia and Moravia. In the same year, 1457, they formed their church fellowship, calling themselves "Unitas Fratrum," or "Fratres Unitatis," the United Brethren From this period of the Reformation, they suffered many cruel and vexatious persecutions; yet they preserved their unity, and formed a kind of alliance with the Waldenses, who had for many centuries opposed many of the corrupt practices and doctrines of the Romish church. After the Reformation, they professed to adhere to the Augsburgh Confession, yet they continued a distinct body. After various persecutions and discouragements, during the seventeenth century, they became in a manner extinct; until about the year 1720, when they began to revive in Bohemia; but as no free toleration could be obtained for them in that country, they agreed to emigrate. Applications were accordingly made to Nicholas Lewis, count of Zinzendorf, who readily granted them permission to settle on his estates in Upper Lusatia. Thither, in 1722, a company of them repaired, and formed the settlement of Herrnhut, from whence they are sometimes called Herrnhutters. Their friend and protector, count Zinzendorf, at length became a convert to the faith and practices of the Moravian Brethren, and, commencing preacher, was, in the year 1735, chosen to be their bishop. From this period the sect of the Moravians began to flourish rapidly. Count Zinzendorf was a zealous and enterprising man, though enthusiastical and mystical in a very high degree. His exertions were of singular service to the cause of the brethren, though his extravagancies sometimes brought them into contempt with the sober and reflecting part of mankind. It is even acknowledged, on the part of the count's friends, that much of the extravagance and absurdity that has been attributed to him owes its origin, or at least its publication, to those persons who wrote his extempore sermons in short-hand, and afterwards published them with all their indelicacies and imperfections about them.

The church of the United Brethren is episcopal, and their church government is conducted with great form and regularity. Questions of dispute are settled by ballot, and in cases of real or supposed importance are often decided by lot. The lot is deemed a solemn appeal to heaven, and is made use of with great seriousness. They have œconomies, or choir-houses, where they live together in community: the single men and single women apart, widows and widowers apart, each under the superintendance of elderly persons of their own class. At Fairfield, near Manchester, there is a Moravian settlement; it is a small village, uncommonly neat and clean, consisting of one large open street, having a handsome chapel, and a small public house for the reception of strangers who visit the settlement from Manchester and the neighbourhood, particularly on Sundays and other holidays. The Moravians are very strict in their attention to the youth of both sexes, and never suffer them to come together, or to marry, without the previous consent of the church; and as the lot must be cast to sanction their union, each receives his partner as a divine appointment. Though the Moravians are united in one body, they are by no means illiberal in their views towards other Christians, who hold what they conceive to be the essentials of religion, and pay divine adoration to Jesus Christ. In doctrine they appear to be inclined to Sabellianism. They address all their prayers to Jesu, or The Lamb, and they have been accused, not without reason, of adopting a phraseology in their hymns and prayers not consistent with the rules of decency and chastity. They are, however, a very harmless and unoffending people. They appear to be Arminians, in opposition to Calvinism, and they reject the use of the term Trinity, and some other popular and unscriptural terms and phrases. In zeal, tempered with modesty, and in silent perseverance in attempting to convert the heathen world to Christianity, the Moravians are unequalled. While some other bodies of Christians are filling the world with pompous details of their missionary labours, and are every day and hour sounding the trumpet of their own fame to all the world, the Moravian missionaries are quietly and successfully pursuing their labour of love in almost every part of the known world. They have settlements in various parts, particularly in the following places: begun 1732, in the Danish West India Islands; in St. Thomas, New Herrnhut, Nisky; in St. Croix, Friedensburg, Friedenstal; in St. Jan, Bethany, and Emmaus. In 1733, in Greenland, New Herrnhut, Lichtensels, and Lichtenau. In 1734, North America, Fairfield in Upper Canada, and Goshen on the river Muskingum. In 1736, at the Cape of Good Hope, Bavians Kloof. In 1738, in South America, among the negro slaves at Paramaribo and Sommelsdyk; among the free negroes at Bambey, on the Sarameca, and among the native Indians at Hope on the river Corentyn. In 1754, in Jamaica, two settlements in Elizabeth parish. In 1756, in Antigua, at St. John's, Grace hill, and Grace bay. In 1760, near Tranquebar in the East Indies, Brethren's Garden. In 1764, on the Coast of Labrador, Nain, Okkak, and Hopedale. In 1765, in Barbadoes, Sharron near Bridgetown. In the same year, in the Russian part of Asia, Sarepta. In 1775, in St. Kitt's, at Basseterre. In 1789, in Tobago, Signal Hill. By the latest accounts published, most of these settlements appear to be in a flourishing state.

Whoever wishes to see a more detailed account of the Moravians will do well to consult Crantz's Ancient and Modern History of the United Brethren, the same author's History of the Mission in Greenland, La Trobe's edition of Spangenburgh's Exposition of Christian Doctrine, also Rimius's Narrative of the Moravians, Bishop Lavington's Moravians compared and detected, and the Periodical Accounts of the Missions of the United Brethren.

MORBID, among physicians, signifies diseased or corrupt, a term applied either to an unsound constitution, or to those parts or humours that are infected by a disease.

MORDANT, in dying. When a substance to be dyed has little or no attraction to the matter on which the colour depends, so as either not to be capable of abstracting it from its solvent, or of retaining it with such force as to form a permanent dye, then some intermediate substance is used, which acts as a bond of union between them: this substance is called a mordant. See DYEING.

MORDELLA, in natural History, a genus of insects of the order Coleoptera; antennæ moniliform or pectinate; head deflected and bent under the neck; shells curved downwards towards the tip; at the base of the abdomen, and before the thighs, is a broad lamina. There are about thirty-four species, divided into sections. A. antennæ, moniliform; fore feelers clavate, hind feelers filiform. B. antennæ pectinate; feelers filiform. The most common of the British species is M. aculeata, measuring little more than a quarter of an inch in length; it is black and smooth; the legs are rather long, and the insect, when disturbed, has the power of leaping or springing to a small distance. It is found on plants in the gardens. M. Clavicornis is entirely piccous; antennæ clavate; an inhabitant of England, and found commonly on the flowers of the rhæum rhabarbarum.

MOREL, the phallus esculentus of Linnæus, a plant that grows on moist banks and wet pastures, and springs up in the early parts of spring. It is used for culinary purposes.

MORINA, in botany, so named in honour of Louis Morin, M. D. member of the Academy of Sciences at Paris, a genus of the Diandria Monogynia class and order. Natural order of Aggregatæ. Dipsaceæ, Jussieu. Essential character: calyx of the fruit one-leafed, toothed; of the flower bifid; corolla irregular; seed one, under the calyx of the flower. There is but one species, *viz.* M. persica, which has a thick taper root, running deep into the ground: stem nearly three feet in height, smooth, and purplish towards the bottom, and green to the top; at each joint come out three or four prickly leaves, four or five inches long, of a lucid green on the upper side, and of a pale green underneath, armed on their edges with spines; flowers axillary on each side, some white and others red on the same plant. It is a native of Persia.

MORINDA, in botany, *Indian mulberry*, a genus of the Pentandria Monogynia class and order. Natural order of Aggregatæ. Rubiaceæ, Jussieu. Essential character: flowers aggregate, one petalled; stigma bifid; drupes aggregate.— There are three species, natives of the East and West Indies.

MORISONIA, in botany, so named in honour of Robert Morison, M. D. a genus of the Monadelphia Polyandria class and order. Natural order of Putamineæ. Capparides, Jussieu. Essential character: calyx single, bifid; petals four; pistillum one; berry with a hard rind, one-celled, many-seeded, pedicelled. There is but one species, *viz*. M. Americana, a native of South America and the islands of the West Indies: flowering there in July, and bearing fruit in November. In Martinico it is called Bois Mahouia, or Devil's wood.

MORMYRUS, in natural History, a genus of fishes of the order Abdominales Generic character: snout protruded, mouth terminal; teeth numerous and notched; aperture of the gills without a cover; gill membrane with one ray; body scaly. This genus has been recently investigated by M. Geoffroy, with considerable minuteness, and he has enumerated nine distinct species, of which Linnæus was acquainted only with three.— The body is compressed, and the tail of a somewhat cylindrical and inflated appearance, and of a considerable length. It contains the glands, from which is secreted the oily matter appearing along the lateral line; the stomach is highly muscular, and the air-bladder nearly of the whole length of the abdomen. Most of the species are inhabitants of the river Nile.

MOROCCO, in commerce, a fine kind of leather, prepared of the skin of an animal of the goat kind, and imported from the Levant, Barbary, &c.

The name was probably taken from the kingdom of Morocco, whence the manner of preparing it was borrowed, which is this: the skins being first dried in the hair, are steeped in clear water three days and nights; then stretched on a tanner's horse, beaten with a large knife, and steeped afresh in water every day till they be well come: then they are thrown into a large vat in the ground full of water, where quick lime has been slaked, and there lie fifteen days; whence they are taken and again returned every night and morning. Then they are thrown into a fresh vat of lime and water, and shifted night and morning for fifteen days longer; then rinsed in clear water, and the hair taken off on the leg with the knife, returned into the third vat, and shifted as before for eighteen days; steeped twelve hours in a river, taken out, rinsed, put in pails, where they are pounded with wooden pestles, changing the water twice; then laid on the horse, and the flesh taken off; returned into pails of new water, taken out, and the hair side scraped; returned into fresh pails, taken out, and thrown into a pail of a particular form, having holes at bottom: here they are beaten for the space of an hour, and fresh water poured on from time to time; then being stretched on the leg, and scraped on either side, they are returned into pails of fresh water, taken out, stretched, and sewed up all round in manner of bags, leaving out the hinder legs as an aperture for the conveyance of a certain mixture.

The skins thus sewed are put into lukewarm water, where dog's excrement has been dissolved. Here they are stirred with long poles for half an hour, left at rest a dozen, taken out, rinsed in fresh water, and filled by a tunnel with a preparation of water and sumac, mixed and heated over the fire till ready to boil; and, as they are filled, the hind legs are sewed up to stop the passage. In this state they are let down into the vessel of water and sumac, and kept stirring for four hours successively; taken out and heaped on one another; after a little time their sides are changed; and thus they continue an hour and a half, till drained. This done, they are loosened, and filled a second time with the same preparation, sewed up again, and kept stirring two hours, piled up, and drained as before. This process is again repeated, with this difference, that they are now stirred only a quarter of an hour; after which they are left till next morning, when they are taken out, drained on a rack, unsewed, the sumac taken out, folded in two from head to tail, the hair side outwards, laid over each other on the leg, to perfect their draining, stretched out and dried; then trampled under foot by two and two, stretched on a wooden table, what flesh and sumac remains scraped off, the hair side rubbed over with oil, and that again with water.

Then they are wrung with the hands stretched, and pressed tight on the table with an iron instrument like that of a currier, the flesh side uppermost; then turned, and the hair side rubbed strongly over with a handful of rushes, to squeeze out as much of the oil remaining as possible. The first course of black is now laid on the hair side, by means of a lock of hair twisted and steeped in a kind of black dye, prepared of sour beer, wherein pieces of old rusty iron have been thrown. When half dried by hanging in the air, they are stretched on a table, rubbed over every way with a paumelle, or wooden-toothed instrument, to raise the grain, over which is passed a light couche of water, then sleeked by rubbing them with rushes prepared for the purpose. Thus sleeked, they have a second couche of black, then dried, laid on the table, rubbed over with a paumelle of cork, to raise the grain again; and, after a light couche of water, sleeked over anew; and, to raise the grain a third time, a paumelle of wood is used.

After the hair side has received all its preparations, the flesh side is paired with a sharp knife for the purpose; the hair side is strongly rubbed over with a woollen cap, having before given it a gloss with barberries, citron, or orange. The whole is finished by raising the grain lightly, for the last time, with the paumelle of cork; so that they are now fit for the market.

Manner of preparing red Morocco. After steeping, stretching, scraping, beating, and rinsing, as before, they are at length wrung, stretched on the leg, and passed after each other into water, where alum has been dissolved. Thus alumed, they are left to drain till morning, then wrung out, pulled on the leg, and folded from head to tail, the flesh inwards.

In this state they receive their first dye, by passing them one after another into a red liquor, prepared with lac, and some other ingredients, which the maroquineers keep a secret. This they repeat again and again, till the skins have got their first colour; then they are rinsed in clear water, stretched on the leg, and left to drain twelve hours; thrown into water, into which white galls pulverized have been passed through a sieve, and stirred incessantly for a day with long poles; taken out, hung on a bar across the water all night, white against red, and red against white, and in the morning the water stirred up, and the skins returned into it for twenty-four hours.

MOROXYLATES, in chemistry, a genus of salts, of which there are two species, *viz.* 1. the moroxylate of lime, found on the bark of a mulberry-tree, crystallized in short needles. Its taste resembles succinic acid. When heated it swells, and emits a vapour which irritates the organs of smell. Its solution precipitates acetate of lead, nitrate of silver, and nitrate of mercury. 2. M. of ammonia, obtained by pouring carbonate of ammonia into the solution of the moroxylate of lime. This solution, when evaporated, yields crystals of moroxylate of ammonia in long slender prisms.

MOROXYLIC *acid*, discovered a few years since by Dr. Thompson on the bark of the morus alba, or white mulberry, growing at Palermo in Sicily. It coated the bark of the tree in small grains, of a yellowish and blackish brown colour. An account of the analysis of this substance may be found in Nicholson's Journal, vol. vii. This acid has the taste of succinic acid; it is not altered by exposure to the air; it dissolves readily in water and alcohol; it does not precipitate the metallic solutions like its salt. From the small quantity of this acid on which the experiments were made, it appears to be compounded of oxygen, hydrogen, and carbon, but the proportion of the constituent parts is not known. The compounds which it forms with alkalies have received the name of MOROXYLATES. See above.

MORTALITY, *bills of*, registers of the number of deaths or burials in any parish or district. The establishment of bills of mortality in Great Britain originated in the frequent appearance of the plague, which formerly made great devastations in this country, and an abstract of the number of deaths was published weekly, to show the increase or decrease of the disorder, that individuals might not be exposed to unfounded alarms, but have some means of judging of the necessity of removal, or of taking other precautions, and government be informed of the propriety or success of any public measures relating to the disorder. Since the disappearance of the plague, these registers have been continued, from the convenience found in ascertaining by them the precise time of the birth or death of individuals, and for the information they furnish respecting the rate of human mortality, and the state of population.

The first directions for keeping parish registers of births and burials were given in 1538, when Thomas Cromwell was appointed the king's vicegerent for ecclesiastical jurisdiction, and in that capacity issued certain injunctions to the clergy, one of which ordains, that every officiatting minister shall, for every church, keep a book, wherein he shall register every marriage, christening, and burial; and the injunction goes on to direct the manner and time of making the entries in the register book weekly, any neglect of which is made penal In 1547 all episcopal authority was suspended for a time, while the ecclesiastical visitors then appointed went through the several dioceses to enforce divers injunctions, among which was that respecting parish registers. This injunction was again repeated in the beginning of the reign of Elizabeth, who also appointed a protestation to be made by the clergy, in which, among other things, they promised to keep the register book in a proper manner. One of the canons of the church of England prescribes very minutely in what manner entries are to be made in the parish registers, and orders an attested copy of the register of each successive year to be annually transmitted to the bishop of the diocese, to be preserved in the bishop's registry. This canon also contains a retrospective clause, appointing that the ancient registers, so far as they could be procured, but especially since the beginning of the reign of Elizabeth, should be copied into a parchment book, to be provided by every parish; which regulation was so well obeyed, that most of the ancient parish registers now extant, commence with that queen's reign, and some of them earlier, quite as far back as the date of the original injunction.

The London bills of mortality are founded upon the reports of the sworn searchers, who view the body after decease, and deliver their report to the parish clerk. The parish clerks are required, under a penalty for neglect, to make a weekly return of burials, with the age and disease of which the person died; a summary of which account is published weekly; and on the Thursday before Christmas-day, a general account is made up for the whole year. These general accounts of christenings and burials, taken by the company of parish clerks of London, were began December 21, 1592; and in 1594 the weekly account was first made public, as also the general or yearly account, until December 18, 1595, when they were discontinued upon the ceasing of the plague; in 1603 they were resumed, and have been regularly continued ever since. The original bills comprehended only 109 parishes, but several others were afterwards included, and in 1660 the bills were new modelled, the twelve parishes in Middlesex and Surry being made a division by themselves, as were likewise the five parishes in the city and liberties of Westminster Several other parishes have been added to them at subsequent periods, but many of them have been merely new parishes formed out of larger ones which were before included, and the total number of parishes now comprehended in the London bills of mortality is 146. They are divided into the ninety-seven parishes within the walls, sixteen parishes without the walls, twenty-three out-parishes in Middlesex and Surry, and ten parishes in the city and liberties of Westminster They give the ages at which the persons die, and a list of the diseases and casualties by which their death was occasioned but little dependence can be placed on the list of diseases, except with respect to some of the most common and determinate.

These bills would afford the means of ascertaining the state of population with sufficient precision, if the proportion of annual deaths to the number of the living could be accurately determined. This, however, previous to the enumeration of 1801, could not be easily found, even in the metropolis, the population of which, as deduced from the bills of mortality, was very differently stated by different writers. Mr. John Graunt, who first published observations on the London bills of mortality in the year 1662, made the proportion dying annually about 1 in 27. Sir William Petty and Dr. Brakenridge afterwards stated it as 1 in 30, and Mr. Maitland 1 in 24⅓, but Dr. Price, who bestowed much attention on this subject, has shown that about the year 1769, at least 1 in 22⅓ of all the inhabitants of London died annually. In fact. the proportion appears to have varied considerably at different periods, and of late years, in consequence of the houses being less crowded with inhabitants, the widening of streets and other improvements, the metropolis has become more healthy, and consequently the proportion dying annually less than formerly. In the "Observations on the results of the Population Act," it is stated that the proportion of annual deaths in London, in the year 1750, appears to have been 1 in 23, and in the year 1801, only 1 in 31.

The following statement of the average of each five years, from 1730, will shew a considerable decrease in the annual number of burials, and an increase of the christenings, which strongly indicate the progressive increase of the population of the metropolis; the proportion of annual deaths to 100 christenings likewise shews that they have approached so nearly to an equality, that the population of London can now nearly support itself, without an annual supply from the country.

5 years endings	Burials.	Christenings.	Proportion to 100 Christen.
1735	25,490	17,517	145
1740	27,494	16,144	170
1745	25,350	14,419	175
1750	25,352	14,496	174
1755	21,080	15,119	139
1760	19,837	14,459	137
1765	23,992	15,931	150
1770	22,888	16,440	139
1775	22,177	17,284	128
1780	20,743	17,256	120
1785	18,880	17,263	109
1790	19,657	18,465	106
1795	20,228	18,800	107
1800	19,131	18,708	102

The bills of mortality in many parts of Great Britain are known to be materially defective; the deficiencies are ascribed chiefly to the following circumstances. 1. Many congregations of dissenters inhabiting towns have their own peculiar burying grounds; as have likewise the Jews, and the Roman Catholics who reside in London. 2. Some persons, from motives of poverty or convenience, inter their dead without any religious ceremony; this is known to happen in the Metropolis, in Bristol, and Newcastle-upon-Tyne, and may happen in a few other large towns. 3. Children who die before baptism are interred without any religious ceremony, and consequently are not registered. 4. Many persons employed in the army and in navigation die abroad, and consequently their burials remain unregistered. 5. Negligence may be supposed to cause some omissions in the registers, especially in those small benifices where the officiating minister is not resident. Whatever may be the total number of deaths and burials, which from these several circumstances are not brought to account, it has been estimated, that about 5000 of them may be attributed to the metropolis, and a large portion of the rest may be ascribed to the other great towns, and to Wales, where the registers are less regularly kept than in England. In Scotland, registers of mortality have not yet been generally established; and those which are kept, are, in many instances, very incomplete.

The total annual amount of burials, as collected pursuant to the population act, authorizes a satisfactory inference of diminishing mortality in England since the year 1780: the number of marriages and baptisms indicates that the existing population of 1801 was, to that of 1780, as 117 to 100, while the amount of registered burials remained stationary during the same period, as will be seen in the following account.

Total number of burials in England and Wales.

Years.	Males.	Females.	Total.
1700	65,752	66,976	132,728
1710	70,606	69,702	140,308
1720	81,156	79,268	160,424
1730	89,085	87,408	176,493
1740	83,706	83,267	166,973
1750	77,149	77,537	154,686
1760	77,750	77,887	155,637
1770	85,952	88,431	174,383
1780	95,845	95,891	191,736
1781	94,505	94,867	189,372
1782	90,189	90,725	180,914
1783	90,606	91,383	181,989
1784	92,851	95,070	187,921
1785	91,548	93,922	185,470
1786	88,330	90,728	179,058
1787	88,123	90,595	178,718
1788	89,227	92,118	181,345
1789	88,411	90,973	179,384
1790	87,954	90,777	178,731
1791	90,895	89,557	180,452
1792	90,895	91,646	182,609
1793	98,640	98,305	196,865
1794	95,511	95,638	191,149
1795	102,086	101,242	203,328
1796	92,289	92,245	184,534
1797	92,292	92,637	184,929
1798	90,657	90,656	181,313
1799	92,078	91,189	183,267
1800	101,686	99,442	201,128

Total number of baptisms and of burials in the twenty-nine years above specified.

	Males.	Females.	Total.
Baptisms	3,285,188	3,150,922	6,436,110
Burials	2,575,762	2,590,082	5,165,844

The proportion of births therefore appears to be 104¼ males to 100 females; of the deaths, 99½ males to 100 females. The average number of burials during the last twenty-one years was about 186,000 per annum.

MORTAR, a preparation of lime and sand mixed up with water, which serves as a cement, and is used by masons and bricklayers in building of walls of stone and brick.

Mortar, when well made and of the best materials, becomes as hard as stone, and adhering very strongly to the surfaces of the stones which it is employed to cement, the whole wall is as one single stone. To obtain this end the lime should be very pure. Earl Stanhope, who has made many experiments on this substance, found that almost every thing depends upon the burning of the lime; it must be almost vitrified to be completely free from the carbonic acid, and then reduced to a fine powder; the sand should be free from clay, and partly in the state of fine sand, and partly in that of gravel; the water should be pure, but if saturated with lime so much the better. The best proportions are said to be three parts of fine sand, four of the coarser kind, one part of quicklime, and as little water as may be. The stony consistence of mortar is partly owing to the absorption of carbonic acid, and partly to the combination of part of the water with the lime; hence, if to common and well made mortar one-fourth part of unslacked lime, reduced to powder, be added, the mortar when dry acquires much greater solidity than it would otherwise. Morveau has given the following proportions.

Fine sand	30
Cement of well baked bricks	30
Slacked lime	20
Unslacked lime	20
	100

The best mortar for resisting water is made by mixing, with lime, puzzolano, a volcanic sand brought from Italy. Basaltes may be substituted in its stead.

Mortar, in chemistry and pharmacy, an utensil very useful for the division of bodies by percussion, trituration, &c. Mortars are of different shapes and sizes, and the matter intended to be broken in them is struck with a pestle made of wood, iron, or marble, according to the different degrees of hardness.

Mortar *piece*, a short piece of ordnance considerably thick and wide; serving to throw bombs, carcases, fire-pots, &c.

The use of mortars is thought to be older than that of cannon; they being employed in the wars in Italy to throw stones and balls of red-hot iron, long before the invention of bombs; which, as Blondel informs us, were first thrown at the siege of Wachtendorch, in Guelderland, in 1588.

It was formerly the opinion of gunners, that only one certain charge of powder, was requisite for each mortar, and that the horizontal range could not be altered but by changing the direction of the piece; but, at present, when a place lying in the same horizontal plane with the mortar, is to be bombarded, they elevate the piece to 45°, and augment or diminish the charge of powder until they can hit the mark. The following advantages introduced this practice: 1. The public powder, is saved as much as possible; because, at a direction of 45°, a less velocity, and consequently, a less charge of powder is required to make any horizontal range, that is necessary to make the same horizontal range at any other elevation. 2. In elevating mortars to their proper directions, gunners seldom come within a degree or two of the proposed elevation, both on account of the imperfection of the instruments which they generally use for that purpose, and the hurry they are in at that time. And in bombarding towns from ships, it is scarce possible to come within two degrees of the designed elevation, because of the agitation of the vessel, which continually changes the direction of the mortar. But by raising the mortar to 45°, the bad consequences of this inaccuracy of elevation are in a great measure prevented, because a small error, above or below 45°, occasions a very inconsiderrble error of amplitude.

For the same reason, also, places lying above or below the horizontal plane, passing through the piece, are bombarded by directing the mortar so as its axis may bisect the angle comprehended between a perpendicular to the horizon at the point of projection, and a line drawn from that point to the mark aimed at; and then augmenting and diminishing the charge of powder until the object be hit.

When the business, therefore, can be effectually done by this middle elevation, it ought certainly to be preferred to any other. However, in the course of a siege

It frequently happens, that several of the cases mentioned under the article GUNNERY are made use of, either by the assailants or defendants. Whence we may infer, that though mortars are oftenest, and most fitly, used at 45° elevation, yet they ought not to be founded of one piece with their bed, because such are not only very costly, but unwieldy, and therefore unfit to be raised to any desired elevation. See GUNNERY.

Mortars are most fit for service, when hung by trunnions and propped with quoins, especially if their carriages be steady enough to prevent the effects of sudden recoiling.

In shooting with mortars, the following general rules should be always observed. 1. To measure the distance of the object aimed at. 2. That the bombs be of equal weight, otherwise the shots will vary. 3. That the carriage be on an exact level to prevent its leaping. 4. That the powder with which the piece is charged, be always of the same strength and quantity. 5. That the charge be always equally rammed down. 6. That the wads be always of wood, tompions, or oakum. 7. That the fuses be fresh made the days on which they are to be used; and that they be of a composition proportionable to the range of the shot in the air, so that the bomb may break at the very moment of, or soon after, its fall; which composition must be such as not to be extinguished though it fall in water, but continue burning till the bomb breaks. See BOMB.

MORTGAGE, signifies a pawn of lands or tenements, or any thing immoveable, laid or bound for money borrowed, to be the creditor's for ever, if the money be not paid at the day agreed upon; the creditor is then called tenant in mortgage, or mortgagee; and the pawner is called the mortgagor. It is called mortgage, because the estate becomes dead and forfeit as to the owner by non-payment at the day, and because, at strict law, the receipt of the rents and profits by the mortgagor does not go in discharge of the debt. Mortgages are either in fee, or for a term of years, and the mortgagor was formerly considered as tenant at will to the mortgagee, but he is now considered to have no legal estate whatever in the land.

The last and best improvement of mortgages is the mode now adopted, where the mortgage is made for a term of years, that the mortgagor, if he has also the fee, covenants to convey the fee to the mortgagee and his heirs, or any person whom he may appoint, in case of default in payment of the money. This mode unites the advantage of a mortgage in fee and for years. Although, after breach of the condition, the estate is absolute at common law in the mortgagee, yet a right of redemption subsists in equity, which is called the equity of redemption, from the benefit of which the heir of the mortgagor cannot be excluded by any covenant, provided the original intent is to mortgage the estate, and not to sell it at first. This right goes to those who would have had the estate if it had not been incumbered. The rule is, once a mortgage and always a mortgage, and even a person who comes in under a voluntary conveyance has the same equity of redemption as the mortgagor. Although therefore the mortgage is forfeited, yet a court of equity will allow the mortgagor, at any reasonable time, to recall or redeem the estate, paying the principal, interest, and costs. This, however, is not allowed, if the mortgagee has been twenty years in possession. The heir at law may have the mortgage redeemed out of the personal assets in the first place as far as they will extend. This privilege is also allowed to the person to whom land mortgaged is devised. Where a mortgagor conceals prior incumbrances upon making a second mortgage, he loses the equity of redemption. Stat. 4. and 5. William and Mary, c. 16. Where a mortgage is made, the mortgagee should have the title deeds, as, under some circumstances, it has been held in equity that a subsequent mortgagee, who has the title deeds of the mortgagor, shall have a prior claim. A third mortgagee also, who buys up the first mortgage, will be preferred to the second if he had no notice of the second. By stat. 7. Geo. II. c. 20, where an action is brought to recover money due on mortgage, or an ejectment to get into the possession of the lands, if the defendant appears, and within six months pays the debt, interest, and costs, the writ shall be staid. And where a bill is filed in equity by the mortgagee, to compel the mortgagor either to pay off the mortgage, or be foreclosed, or prevented from having his equity of redemption, the like time is allowed, and afterwards the estate is absolutely foreclosed. But the act does not extend to cases, where the mortgagor disputes the validity or fairness of the mortgage. By stat. 14. Geo. III. c. 79, sect. 2. estates in the West Indies may be mortgaged here at West India interest. A remainder man may force the tenant in tail to keep down the interest, but not to redeem a mortgage.

MORTMAIN, signifies an alienation of lands and tenements to any corporation, and their successors, as bishops, parsons, vicars, &c. which is restrained in Magna Charta, and cannot be done without the King's license. The disposing of property to hospitals is allowed by 35 Eliz. c. 5. and various enactments have been made, to prevent the influence of priests and crafty men from taking advantage of the last hours of the lives of weak devotees, by obtaining gifts in mortmain or perpetuity. The chief of these is the stat. 9. Geo. II. c. 36, (called the statute of mortmain) that no manors, lands, tenements, rents, advowsons, or other hereditaments, corporeal or incorporeal, whatsoever, nor any sum or sums of money, goods, chattles, stocks in the public funds, securities for money, or other personal estate whatever, to be laid out or disposed of in the purchase of any lands, tenements, or hereditaments, shall be given, limited, or appointed by will, to any person or persons, bodies politic or corporate, or otherwise, for any estate or interest whatsoever, or any ways charged or incumbered by any person or persons whatsoever in trust, or for the benefit of any charitable use whatsoever; but such gift shall be by deed, indented, sealed, and delivered, in the presence of two or more credible witnesses, twelve calendar months at least before the death of such donor, and be enrolled in the high Court of Chancery within six calendar months after execution, and the same to take effect immediately after the execution for the charitable use intended, and be without any power of revocation, reservation, or trust, for benefit of the donor. And by the fourth section all gifts or incumbrances otherwise made are void. This act however does not extend to prevent the making bequests, merely of money, to charitable uses, and it is much to be feared that certain fanatics, who are what the monks were formerly, have taken advantage of this, to obtain great bequests of property to improper purposes. In the Evangelical Magazine is published frequently a form of a bequest for the encouragement of Calvinistic Methodism.

MORUS, in botany, *mulberry tree*, a genus of the Monoecia Tetrandria class and order. Natural order of Scabridæ. Urticæ, Jussieu. Essential character: male, calyx four-parted; corolla none: female, calyx four-leaved; corolla none; styles two; calyx becoming a berry; seed one. There are seven species, of which we shall notice the M. papyrifera, paper mulberry tree. The inhabitants of Japan make paper of the bark; they cultivate the trees for this purpose on the mountains, much after the same manner as osiers are cultivated with us, cutting down the young shoots in December, after the leaves are fallen; these, being divided into rods of three feet in length, are gathered into bundles to be boiled; they are placed erect and close in a large copper properly closed, and the boiling continued till the separation of the bark shews the naked wood, after which, by a longitudinal incision, the bark is stripped off, and dried, the wood being rejected. To purify the bark they keep it three or four hours in water; when it is sufficiently softened, the cuticle, which is of a dark colour, together with the greenish surface of the inner bark, is pared of; at the same time the stronger bark is separated from the more tender; the former making the whitest and best paper; the latter a dark and inferior kind.

The finest and whitest cloth, worn by the principal people at Otaheite, and in the Sandwich islands, is made of the bark of this tree. The bread-fruit tree makes a cloth inferior in whiteness and softness, worn chiefly by the inferior people. Cloth is also made of a tree resembling the wild fig-tree of the West Indies; it is coarse and harsh, the colour of the darkest brown paper; but it is the most valuable, because it resists the water. This is perfumed, and worn by the chiefs as a morning dress in Otaheite.

MOSAIC. This term is applied to the art of composing figures in imitation of nature and painting, by the judicious arrangement of fragments of marble and coloured glass, inserted in a composition, which, becoming hard soon after the operation is completed, renders the subject a durable picture for ages. The learned are doubtful of the origin of the term, which is said by some to be derived from musaicum, which may be supposed to convey an idea of an exceeding curious and difficult representation of natural objects in this way.

It is impossible to ascertain the æra of the invention; but it is by no means improbable, that it was suggested by the forming of figures in pavements with different coloured stones or marbles, the durability of which substances, and their resistance of damps, suggested the introduction of imitations of objects on walls and parts of buildings exposed to the action of the weather; those, however, probably were at first very rude and tasteless performances. The Greeks transmitted the art to the Romans: it was perpetuated in Italy, according to the Abbe Berthelemy, during the incursions of the Barbarians, and brought to perfection in Rome in subsequent ages, where the works of the best masters still remain for the admiration of the present and many future generations. The fragments, which are generally of marble, and cut into cubical forms, were distributed with great skill and judgment in the most impervious cement, and being thus firmly connected, the surface received a high polish. The elegance of the work consists in the true disposition of the fragments, their diminutive size, and the richness of the colours: of the latter, several of the principal were obtained from the quarries of Sicily and Greece, "at the same time that the different shades were found blended in different species of marble. The whiteness and purity of snow was emulated by the Parian; alabaster, beautifully fair, by that from Synnada, in Phrygia; and unsullied ivory, by a different description from Asia Minor; the marble from Jassûs, in Caria, furnished a glowing crimson; and those of Sicily, granites and rubies." The intermediate colours and gradations of colours were supplied by several means, and particularly enamels, as appears from the mosaic works discovered in the Jesuits' college at Frescati, which were conveyed to the cabinet belonging to the order at Rome: in those the blue is a composition or paste; and in one of the pieces are two shades of yellow, one of which is marble, and the other brick.

There are specimens of ancient mosaic, composed exclusively of enamel, and such were those which adorned the floors and walls of a house discovered in the last century at Surrento, and which are attributed to Pollio. Among the pieces preserved at Rome, there were several that agreed with the ideas generally entertained of this laborious and durable species of ornament: but far superior were those valuable fragments found by M. Furietti in Adrian's villa at Tivoli, which he described in a work of great judgment and erudition. One of the pieces alluded to represents four doves, arranged on the rim of a vase, and is equally remarkable for the excellence of the performance, and the connection of the subject with another treated by Sosus, and taken from a house at Pergamus. "The Abbe, observes M. Furietti, is of opinion, that Adrian had caused it to be removed to embellish his house at Tivoli; but may we not as fairly presume, that the emperor was satisfied with a copy of it? An idea that would solve some difficulties found in the writings of Pliny."

The monument, however, most interesting to antiquaries, was some years past preserved at the palace of the Princes of the Barbarini family at Palestrina, and is the celebrated work in mosaic, which, in its original destination, covered the sanctuary of the temple at Preneste. This magnificent specimen of ancient skill is described by Berthelemy as being about eighteen feet in length, and rather more than fourteen in breadth, and the attributes of the hunters and animals represented on a mountainous country, in the upper part, left him no reason to doubt that the scene was intended for Egypt. Greek characters inscribed beneath the animals give their names. "In the lower part of the mosaic, we perceive the Nile, winding round several small islands; boats with oars, or sails; Egyptians in pursuit of crocodiles, which conceal themselves among the rushes; rustic cottages; superb buildings; priests performing religious ceremonies in their temples; Egyptian women, reclined under a bower on the borders of a canal, with cups or musical instruments in their hands; and, lastly, a magnificent tent, near which a general, followed by several soldiers, armed with lances and shields, advances towards a female with a palm-branch in her left hand, and in her right a species of garland, which she holds out to him. It was natural," adds this learned writer, "that the sagacity of antiquaries should be employed on so rich a composition. Father Kircher discovered in it the vissitudes of fortune; Cardinal Polignac, the arrival of Alexander in Egypt; and Father Montfaucon, exhibitions of the Nile, of Egypt, and of Ethiopia." Barthelemy, with more probability, thought it represented the arrival of the Emperor Adrian in a province of Upper Egypt.

Very few, if any, pictures in mosaic have been found in England; but numbers of pavements of Roman origin have often been, and still are continually discovered. Those necessarily differ considerably from the delicate and beautiful works already noticed; and yet the neatness of their component parts, and the elegance of their figures, obtain and deserve admiration. Of all the pavements in mosaic left in English churches, not one can be compared with that placed by Richard Ware, Abbot of St. Peter's, Westminister, before the high altar of the church, in 1272, which is thus described by Malcom, in the first volume of "Londinium Redivivum." "The materials are lapis-lazuli, jasper, porphyry, alabaster, Lydian, and serpentine marbles and touchstone. The centre of the design is a large circle, whose centre is a circular plane of porphyry, three spans and a quarter in diameter; round it stars of lapis-lazuli, pea-green, red and white, which being of most beautiful colours, have been subject to depredations; those enclosed by a band of alabastar; and without, a border of lozenges, red and green; the half lozenges contain triangles of the same colours. A dark circle held brass letters, the places of which may be seen, but are now reduced to six: R.E.MN.TA The extreme lines of this great circle run into four smaller circles facing the cardinal points: that to the east, a centre of orange and green variegated: round it a circle of green and red wedges; without that, lozenges of the same calours; and completed by a dark border. To the north, the circle has a sexagon centre of variegated grey and yellow; round it a band of porphyry and a dark border. The west circle nearly similar. The south, a black centre within a variegated octagon. A large lozenge encloses all the above circle, which is formed by a double border of olive-colour; within which, on one corner only, are 138 circles intersecting each other, and each made by four oval pieces, enclosing a lozenge. The other parts vary in figure; but would take many pages to describe.

The above lozenge has a circle on each of its sides, to the north-west, south-west, north-east, and south-east. The first contains a sexagon, divided by lozenges of green; within which are forty-one red stars. In the intersections red triangles. Green triangles form a sexagon round every intersection. The second contains a sexagon; within it seven stars of red and green, forming several sexagons, containing yellow stars. The third has a sexagon, formed by intersecting lines into sexagons and triangles; within the former stars of red and green. The latter sixteen smaller triangles of red, green, and yellow. The last a sexagon, with thirty-one within it, filled by stars of six rays, green and yellow. The space within the great lozenge round the circles is composed of circles, stars, squares, lozenges, and triangles, the component parts of which are thousands of pieces of the above shapes. The whole of the great lozenge and circles is enclosed by a square; the sides to the cardinal points. It has held other parts of the inscription: of this O and C only remain on the eastern side, N O on the south, none on the west, and E on the north. The four outsides are filled by parallelograms and circles of considerable size, all divided into figures nearly similar to those described."

The above descriptions of mosaic pictures and mosaic pavements will convey a competent idea of the nature of the art. The manner in which they are composed is explained by Keysler, whose accuracy is almost proverbial. According to this valuable author, persons were constantly employed at Rome in making copies, in mosaic, of those excellent pictures which adorned the walls of St. Peter's church, to replace the latter, as the damps of the building were annually and gradually destroying them. The materials used in his time were small pieces of glass, tinted with different gradations of colours, in the manner of the fine worsted used for needle work. The glass was cast in thin plates, and afterwards cut into pieces of different lengths and breadths: some of those intended for the composition of figures to be placed on vaults and ceilings were above half an inch in width; but those used for subjects situated near the spectator were formed by pieces not thicker than a common pin, of which two millions are said to be necessary to compose a portrait four feet square. The substance prepared to receive these shreds of glass is a kind of paste, composed of calcined marble, fine sand, gum tragacanth, the white of eggs, and oil. As some time elapses before the ground hardens, there is no difficulty immediately arising from the act of placing the glass properly, or in removing those which may be found misplaced; but after a certain interval it becomes so extremely solid, that nothing less than violence has any affect upon it. Keysler mentions, that "the paste is first spread in a frame of wood, which must not be less than a foot in breadth and thickness, if the piece be any thing large." The frame is secured by brass nails to a plane of marble or stone; and as some of the most important subjects are twenty feet in length, and fifteen in breadth, an idea may be formed of their very great weight. The fragments of glass are arranged in their proper gradations in cases, which are placed before the artist in the manner the types are set before compositors in printing. The former were so very accurate in imitating the most beautiful strokes of the pencil, that the difference, according to Keysler, seems to consist only in the colours of the copy being more vivid and brilliant than those of the painting. When the copy is completed, they polish them in the same manner usual with mirrours; and after this operation is performed, it is almost impossible to discover that they are composed of an infinite number of fragments, as they rather resemble rich pictures covered with glass. Those pieces intended for distant view are never polished.

The pieces of which mosaic work were originally formed were very large, and sometimes gilded and silvered. About the close of the third century, a Florentine, named Andrea Tasai, contemporary with Cimabne, the restorer of the art of painting, introduced an improved manner of executing it, which soon attracted the attention of the rich and powerful, and in consequence mosaic paintings became much more common than they had been for a long time before. Tasai, however, does not deserve the sole merit of reviving the art, as he acquired his skill from Apollonius, a Greek, who had performed several very fine pieces for St. Mark's church at Venice.

A few specimens of the gilded manner of executing figures in mosaic may still be seen in England, and particularly in Westminster Abbey, where the tombs of Edward the Confessor and of Henry III. have been adorned in this way in fanciful figures, some of which are perfect, but the greater part are destroyed by the silly practice of picking out the fragments of glass, to discover what may be seen on each side—the mode of setting them in the cement. "How much," says Keysler, "this curious art has been improved, during the two last centuries, may be easily seen, by comparing the coarse works in some of the old cupolas of the chapels in St. Peter's church with the other pieces lately erected there. The studs in these old works are made of clay burnt, and the surface only tinctured with various colours."

Another description of mosaic work has been made by the moderns, in the following manner. That wholly of marble is done by preparing a piece of the same material, either white or black. The artist having traced the design upon this plane, he excavates or cuts it with a chisel, perhaps to the depth of an inch: other pieces of the colour necessary for the parts are then shaped as correctly as possible to fit the excavations, and set in them with cement. Thus far completed, the artist finishes the shading by drawing intersecting lines with a pencil, and those being cut into the design as before, they are filled with a black composition, partly consisting of Burgundy pitch, which when rubbed off and rendered smooth by polishing, affords an imperfect picture, very greatly inferior to the beautiful works produced in the manner before described, and rather deserving the term of inlaid work than mosaic. There are other methods of imitating this splendid production of art; but with materials that prevent a possibility of deception; indeed their poverty of effect has operated to banish them from the palaces of Europe almost universally.

MOSCHUS, the *musk*, in natural history, a genus of Mammalia of the order Pecora. Generic character: no horns; eight fore-teeth in the lower jaw; tusks solitary in the upper jaw, exserted. There are six species.

M. moschiferus, or the Tibetian musk, is found in the country from which it takes its name, and also in several provinces of China. Its peculiar perfume was well known to the ancients; but no correct description of the figure of this animal appears to have been published till towards the close of the seventeenth century. It more nearly resembles a roebuck than any other creature. It is about three feet and a quarter long, and about two and a half high. The upper jaw is much longer than the under, and contains two tusks, covered inwards, and sharp on the inner side, about two inches long, and visible when the mouth is shut. The substance of these is very similar to ivory. The musk abounds in the mountainous parts of the countries above mentioned, in the extensive forests of pine trees, and displays extreme agility when pursued by the hunters, bounding from rock to rock with the most elastic energy, and securing itself frequently by its swift progress over rugged and pointed prominences, and by reaching the most elevated and tremendous summits. Musks are valued for food, which, however, at particular seasons of the year, is extremely strong, and to those not used to it scarcely tolerable. But they are principally pursued for the sake of that substance known by the name of musk, and in high estimation as a perfume, and of no little repute also as a medicine, particularly in cases of nervous affection and convulsion. This substance is contained in a tumour attached to the abdomen of the animal, which contains a quantity of soft, unctuous, brownish matter, proportionate to the health and age of the creature from which it is taken. The smell of this substance is most powerful and pungent, and those who make purchases of the article, and in consequence have to compare the quality of various masses of it, are obliged to apply particular precautions, to prevent its overwhelming their senses by its stimulating power. It is not extremely uncommon for a considerable dealer in this article to purchase in one journey seven or eight thousand bags of it, which proves the animals from which it is procured to be extremely numerous. The Tibetian musk is considered as by far the best. This substance is found only in the male.

M. pygmæus, or the Guinea musk, is of a bright bay colour, and only about nine inches in length, of an elegant shape, and such slender legs, that they scarcely exceed the size of a swan's quill. It inhabits many parts of the East Indies, but is most common in the island of Java, the natives of which catch them in snares, and inclosing them in cages, convey them to the markets, where they are sold at very low prices. Their legs are often converted to the purpose of tobacco stoppers, and are ornamented with gold and silver.

M. Americanus, or Brazilian musk, is about the size of a roebuck, and is peculiar to the southern countries of America, particularly Guiana and Brazil. These animals are called by the Indians does, from the circumstance of neither sex possessing horns. They occasionally swim across rivers, and when engaged in these efforts are most easily taken. By land they are active and swift in a very high degree, and so secure and rapid in their progress over projecting rocks, as to occasion the successful hunting of them to be an exercise of no small fatigue and dexterity. Their flesh is in considerable request among the Indians.

MOSQUE, a temple, or place of religious worship, among the Mahometans. All mosques are square buildings, generally built with stone: before the chief gate there is a square court, paved with white marble, and low galleries round it, whose roof is supported by marble pillars. In these galleries the Turks wash themselves before they go into the mosque. In each mosque there is a great number of lamps; and between these hang many crystal rings, ostriches' eggs, and other curiosities, which, when the lamps are lighted, make a fine show. As it is not lawful to enter the mosques with shoes or stockings on, the pavements are covered with pieces of stuff sewed together, each being wide enough to hold a row of men sitting, kneeling, or prostrate. The women are not allowed to enter the mosque, but stay in the porches without. About every mosque there are six high towers, called minarets, each of which has three little open galleries, one above another; these towers, as well as the mosques, are covered with lead, and adorned with gilding and other ornaments; and from thence, instead of a bell, the people are called to prayer by certain officers appointed for that purpose. Most of the mosques have a kind of hospital belonging to them, in which travellers, of what religion soever, are entertained during three days. Each mosque has a place called Tarbe, which is the burying place of its founders: within which is a tomb six or seven feet long, covered with green velvet or sattin, at the end of which are two tapers, and round it several seats for those who read the koran, and pray for the souls of the deceased.

MOSS. See Musci.

MOTACILLA, the *wagtail*, and the *warbler*, in natural history, a genus of birds of the order Passeres. Though differing somewhat considerably in manners, these birds are ranked by Gmelin under one genus. Generic character: bill subulate and straight; mandibles nearly equal; nostrils small and rather depressed; tongue cloven. Gmelin enumerates one hundred and ninety-four species, of which it will be sufficient to notice the few following.

Of the wagtails it may be observed, that their movements are extremely alert, and that their tails are particularly long, and perpetually jerked up and down by them. Their progress is by running, rather than springing. They rarely perch on trees. Their flight is waving, and accompanied by a twittering sound; and their food consists of flies and other insects, in pursuit of which they will often follow the husbandman with his plough, and also the movements of flocks of sheep.

M. alba, or the pied wagtail, is very common in England, frequenting the shallow borders of streams and lakes, in search of worms and insects, and often advancing into the water, so as to cause its feet to facilitate its discoveries. Its note is totally uninteresting. It changes its situations in this island from the north to the south, as winter advances. It builds on the ground a warm and well-compacted nest, and the female continues her maternal attentions to her young for several weeks after they are able to fly, protecting them with great intrepidity, and feeding them with incessant assiduity. See Aves, Plate X. fig. 4.

The warblers are composed of a great variety of classes, different in striking particularities of habit as well as in size. They are found in almost all parts of the world, perch on trees, move by leaping, and rarely utter any sounds during their flight. They are more numerous than any genus of birds, and abound principally in the warm latitudes of the globe, where insects, their chief food, are found in never-failing supplies.

M. luscinia, or the nightingale, is somewhat larger than a hedge sparrow, and on the upper part of its body of a rusty-brown colour. It is common in several parts of Great Britain; but is seldom seen so far north as Yorkshire, or so much to the west as Cornwall, or even Devonshire. It arrives in April, and quits in August. The males arrive about a week before the females. Their winter residence appears to be unascertained, and never takes place in Great Britain, France, Germany, Greece, or Italy, and is generally supposed to be in Asia, in various parts of which they are found, and highly valued for their powers of melody. In Japan and in Aleppo this is said to be particularly the case. In the latter place they are kept tame, and hired out, to give vivacity and harmony to almost every festival and entertainment. In Persia the nightingale sings in great perfection, and Fryer, in his travels through that country, mentioning this bird, says, "this sweet harbinger of the light is a constant cheerer of the groves of Persia, charming, with its warbling strains, the heaviest soul into a pleasing ecstacy." By another interesting writer, the nightingale is said to "begin its song with a slow and tumid voice; by degrees the sound opens, and swelling, it bursts with loud and vivid flashes; it flows with smooth volubility; it faints and murmurs; it shakes with rapid and violent articulations. The soft breathings of love and joy are poured from the inmost soul, and every heart melts with delicious langour; pauses occasionally occur, to prevent satiety and give dignity and elevation; the mild silence of evening heightens the general effect, and no rival interrupts the happy and interesting scene."

Nightingales build in low and close bushes, and sometimes breed three times in a year. The female sustains the undivided fatigue of incubation, while the male, at a short distance only, enlivens her with his exquisite strains. Nightingales are never seen even in flocks of a very small number. They live chiefly on insects and berries, on worms, and the eggs of ants. They are caught without particular difficulty, having little cunning, though much timidity. Old ones cannot easily be induced to sing in confinement: yet if kept tranquil and unirritated, will at length recur to song, and continue it through a great part of the year as fluently as those which have been reared from the nest. See Aves, Plate X. fig. 4.

M. rubecula, or the redbreast, is found in almost every country of Europe, and, with respect to most, is supposed to be, migratory. These birds are never seen in flocks, not even previously to their migration from any country, this being performed by each bird singly. With respect to England, many are known to remain there during the whole year, and, indeed in winter they are more seen than in the summer, when they have withdrawn to the woods to build their nests and rear their young. In order to keep the nest effectually concealed, it is often covered with vegetable substances, and a narrow entrance only is left to it, under a large collection of leaves. They subsist on insects and worms, which, however, they are observed never to devour alive, and often take great pains to kill before they will swallow them.—Their extreme familiarity with mankind has attracted the attention of every age, and bestowed upon them a privileged exemption from that wanton destruction and mischief, which are the fate of most of the aerial tribes. They will follow the movements of the hoe or spade in the garden, and in winter will enter the door or window of a habitation, and pick up the fragments that have fallen, as if conscious of security and welcome. The song of this bird, particularly during the incubation of the female, is highly animated and melodious.

M. hippolais, or the pettichaps, conceals itself in the thickest parts of bushwood, and has mimitic powers of very considerable and amusing extent, frequently beginning his varied career of song with the notes of the swallow, and after following it up with numerous intermediate links, terminating with the rich and full song of the blackbird.—Though frequently to be heard, it is very rarely seen.

M. atricapilla, or the black-cap, is migratory in England, arriving in April, and withdrawing in September. It feeds not only on insects, but also on various berries, particularly those of ivy. The male takes his share in the labours of incubation, and is highly assiduous also in procuring for the female flies and insects during her term of confinement. Its song is in a great degree similar to the nightingale's, and, when it is exercised in its best style, for it is sometimes regular and continued, and sometimes abrupt and transient, must be considered superior to that of any of the warblers, the nightingale alone excepted.

M. regulus, or the golden-crested wren, is the smallest of European birds, when stripped of its feathers being not quite an inch long. Its food consists of small worms, several sorts of seeds, insects and their eggs, which last they find plentifully in the fissures of the bark of trees, particularly the oak, to which they seem greatly attached. In a branch of this, or some other tree, it fixes its nest, suspending it by a sort of cord formed of the same materials as the nest itself. The regulus possesses great agility, moving in every direction with perfect ease and unwearied alertness. It bears every latitude, from great heat to very rigorous cold, and is by some much admired for its melody. It remains in England the whole year.

M. œnanthe, or the wheat-ear, visits England about the middle of March, and builds its nest under a clod, in lands which have been recently ploughed. It lives on worms and insects, and is a regular follower of the ploughman in his progress over the field. In some parts of England these birds are taken in vast numbers for the table, two thousand dozen having been taken in snares framed of horse hair, in one season and district only. They are sent to the markets of the metropolis, and sold at the rate of sixpence per dozen. By some they are considered as not inferior to the ortolan.

MOTHER *of pearl* is that beautiful natural white enamel, which forms the greater part of the substance of the oyster shell, particularly of the pearl oyster. See SHELL.

MOTHER *water*, in chemistry, is the uncrystallizable residue of a compound saline solution: thus the liquor left in a salt pan, after the salt is taken out, is the mother-water.

MOTION is defined to be the continued and successive change of place. There are three general laws of motion. 1. That a body always perseveres in its state of rest, or of uniform motion in a right line, till by some external force it be made to change its state; for, as body is passive in receiving its motion, and the direction of its motions, so it retains them, or perseveres in them, without any change, till it be acted on by something external. From this law it appears, why we inquire not, in philosophy, concerning the cause of the continuation of motion or rest in bodies, which can be no other than their inertia; but if a motion begin, or if a motion already produced is either accelerated or retarded, or if the direction of the motion is altered, an inquiry into the power or cause that produces this change is a proper subject of philosophy. 2. The second general law of motion is, that the change of motion is proportional to the force impressed, and is produced in the right line in which that force acts. When a fluid acts upon a body, as water or air upon the vanes of a mill, or wind upon the sails of a ship, the acceleration of the motion is not proportional to the whole force of those fluids, but to that part only which is impressed upon the vanes or sails, which depends upon the excess of the velocity of the fluid above the velocity which the vane or sail has already acquired: for if the velocity of the fluid be only equal to that of the vane or sail, it just keeps up with it, but has no effect either to advance or retard its motion. Regard must always be had to the direction in which the force is impressed, in order to determine the change of motion produced by it: thus, when the wind acts obliquely with respect to the direction of a ship, the change of her motion is first to be estimated in the direction of the force impressed: and thence, by a proper application of mechanical and geometrical principles, the change of the motion of the ship in her own direction is to be deduced. 3. The third general law of motion is, that action and re-action is equal.

with opposite directions, and are to be estimated always in the same right line. Body not only never changes its state of itself, but resists, by its inertia, every action that produces a change in its motion: hence, when two bodies meet, each endeavours to persevere in its state, and resists any change; the one acquires no new motion but what the other loses in the same direction; nor does this last lose any force but what the other acquires: and hence, though by their collision motion passes from the one to the other, yet the sum of their motions, estimated in a given direction, is preserved the same, and is unalterable by their mutual actions upon each other.

All motion may be considered absolutely or relatively. Absolute or real motion, says Mr. Maclaurin, is when a body changes its place in absolute space; and relative motion is, when a body changes its place only with relation to other bodies. From the observation of nature, every one knows that there is a motion; that a body in motion perseveres in that state, till, by the action of some power, it is necessitated to change it; that it is not in relative or apparent motion in which it perseveres, in consequence of its inertia, but in real or absolute motion. Thus the apparent diurnal motion of the sun and stars would cease, without the least power or force acting upon them, if the motion of the earth was stopped; and if the apparent motion of any star was destroyed by a contrary motion impressed upon it, the other celestial bodies would still appear to persevere in their course. See INERTIA.

To make this matter still plainer, Mr. Martin observes, that space is nothing but an absolute and infinite void, and that the place of a body is that part of the immense void which it takes up or possesses: and this place may be considered absolutely, or in itself, in which case it is called the absolute place of the body; or else with regard to the place of some other body, and then it is called the relative or apparent place of the body.

Now, as motion is only the change of place in bodies, it is evident that it will come under the same distinction of absolute, and relative or apparent. All motion is in itself absolute, or the change of absolute space; but when the motions of bodies are considered and compared with each other, then are they relative and apparent only; they are relative, as they are compared to each other; and they are apparent, only insomuch that not their true or absolute motion, but the sum or difference of the motions only, is perceivable to us.

In comparing the motions of bodies, we may consider them as moving both the same way, or towards contrary parts: in the first case, the difference of motion is only perceived by us; in the latter, the sum of the motions. Thus, for example, suppose two ships, A and B, set sail from the same port upon the same rhumb, and that A sails at the rate of five miles per hour, and B at the rate of three: here the difference of the velocity (*viz.* two miles per hour) is that by which the ship A, will appear to go from the ship B, forwards, or the ship B, will appear at A to go with the same velocity backwards, to a spectator in either respectively.

If the two ships, A and B, move with the same degree of velocity, then will the difference be nothing, and so neither ship will appear to the other to move at all. Hence it is, that though the earth is continually revolving about its axis, yet, as all objects on its surface partake of the same common motion, they appear not to move at all, but are relatively at rest.

If two ships, A and B, with the degrees of velocity as above, meet each other, the one will appear to the other to move with the sum of both velocities, *viz.* at the rate of eight miles per hour; so that in this case the apparent motion exceeds the true, as in the other it fell short of it. Hence the reason why a person, riding against the wind, finds the force of it much greater than it really is; whereas, if he rides with it, he finds it less.

The reason of all these phenomena of motion will be evident, if we consider we must be absolutely at rest, if we would discern the true or real motions of bodies about us. Thus a person on the strand will observe the ships sailing with their real velocity; a person standing still will experience the true strength and velocity of the wind; and a person placed in the regions between the planets, will view all their true motions, which he cannot otherwise do, because in all other cases the spectator's own motion must be added to, or subtracted from, that of the moving body, and the sum or difference is therefore the apparent or relative motion, and not the true.

Motion is also either equable or accelerated. Equable motion is that by which a body passes over equal spaces in equal times. Accelerated motion is that which is continually augmented or increased, as retarded motion is that which continually decreases; and if the increase or decrease of motion be equal in equal time, the motion is then said to be equally accelerated or retarded. Equable motion is generated by a single impetuous stroke; thus the motion of a ball from a cannon is produced by the single action of the powder in the first moment, and, therefore, the velocity it first sets out with would always continue the same, were it void of gravity, and to move in an unresisting medium; which, therefore, would be always equable, or such as would carry it through the same length of space in every equal part of time. Hence we may determine the theorems for the expressions of the time (T), the velocity (V), and the space (S), passed over in equable or uniform motion very easily, thus:

If the time be given, or remain the same, the space passed over will be as the velocity, *viz.* S : V; that is, with twice the velocity, twice the space; with three times the velocity, three times the space will be passed over in the same time, and so on.

If the velocity be given, or remain the same, then the space passed over will be as the time, *viz.* S : T; that is, it will be greater or less, as the time is so.

But if neither the time nor velocity be given or known, then will the space be in the compound ratio of both, *viz.* S : T V. Hence, in general, since S : T V, we have $V : \frac{S}{T}$ that is, the velocity is always directly as the space, and inversely as the time. And also $T : \frac{S}{V}$, that is, the time is as the space directly, and as the velocity inversely; or, in other words, it increases with the space, and decreases with the velocity.

If, therefore, in any rectangle, one side represent the time, and the other side the velocity, it is evident that the area of the said rectangle will represent the space passed over by an uniform motion in that time, and with that velocity.

Accelerated motion is produced by a constant impulse of power, which keeps continually acting upon the body, as that of gravity, which produces the motion of falling bodies; which sort of motion is constantly accelerated, because gravity every moment adds a new impulse, which generates a new degree of velocity; and, the velocity thus increasing, the motion must be quickened each moment, or fall faster and faster, the lower it falls.

In like manner a body thrown perpendicularly upward, as a ball from a cannon, will have its motion continually retarded, because gravity acts constantly upon it in a direction contrary to that given it by the powder; so that its velocity upwards must be continually diminished, and its motion as continually retarded, till at last it be all destroyed. The body has then attained its utmost height, and is for a moment motionless, after which it begins to descend with a velocity in the same manner accelerated, till it comes to the earth's surface.

Since the momentum (M) of a body is compounded of the quantity of matter (Q), and the velocity (V), we have this general expression M = Q V, for the force of any body, A; and suppose the force of another body, B, be represented by the same letters in italics, *viz.* *M = Q V*.

Let the two bodies, A and B, in motion, impinge on each other directly; if they tend both the same way, the sum of their motions towards the same part will be Q V + *Q V*. But if they tend towards contrary parts, or meet, then the sum of their motions towards the same part will be Q V — *Q V*: for since the motion of one of the bodies is contrary to what it was before, it must be connected by a contrary sign. Or thus; because, when the motion of B conspires with that of A, it is added to it; so, when it is contrary, it is subducted from it, and the sum or difference of the absolute motions is the whole relative motion, or that which is made towards the same part. Again, this total motion towards the same part is the same, both before and after the stroke, in case the two bodies, A and B, impinge on each other; because, whatever change or motion is made in one of those bodies by the stroke, the same is produced in the other body towards the same part: that is, as much as the motion of B is increased or decreased towards the same part by the action of A, just so much is the motion of A diminished or augmented towards the same part by the equal re-action of B, by the third law of motion.

In bodies not elastic, let x be the velocity of the bodies after the stroke, (for, since we suppose them not elastic, there can be nothing to separate them after collision; they must therefore both go on

together, or with the same celerity.) Then the sum of the motions after collision will be $\mathrm{Q}\,x + Q\,x$; whence, if the bodies tend the same way, we have $\mathrm{Q\,V} + Q\,V = \mathrm{Q}\,x, + Q\,x$, or if they meet, $\mathrm{Q\,V} - Q\,V = \mathrm{Q}\,x + Q\,x$; and accordingly, $\frac{\mathrm{Q\,V} + Q\,V}{\mathrm{Q} + Q} = x$, or
$\frac{\mathrm{Q\,V} + Q\,V}{\mathrm{Q} + Q} = x$.

If the body (B) (Plate XI. Miscel. fig. 1.) be at rest, then $V = o$, and the velocities of the bodies after the stroke will be $\frac{\mathrm{Q\,V}}{\mathrm{Q} + Q} = x$.

Thus if the bodies be equal (*viz.* $\mathrm{Q} = Q$, fig. 1.) and A with 10 degrees of velocity impinge on B at rest; then $\frac{\mathrm{Q\,V}}{\mathrm{Q} + Q} = \frac{10}{2} = 5 = x$. If $\mathrm{Q} = Q$, and $\mathrm{V} : V :: 10 : 6$, (fig. 2.) we have $\frac{\mathrm{Q\,V} + Q\,V}{\mathrm{Q} + Q} = \frac{16}{2} = 8 = x$, the velocity after the stroke.

If the bodies are both in motion, and tend the contrary way; then when $\mathrm{Q} = Q$ (fig. 3.) and $\mathrm{V} = V$, it is plain $\frac{\mathrm{Q\,V} - Q\,V}{\mathrm{Q} + Q} = o = x$; that is, the bodies which meet with equal bulks and velocities, will destroy each other's motion after the stroke, and remain at rest. If $\mathrm{Q} = Q$, (fig. 4.) but $\mathrm{V} : V :: 6 : 14$, then $\frac{\mathrm{Q\,V} - Q\,V}{\mathrm{Q} + \mathrm{Q}} = \frac{-8}{2} = -4 = x$; which shews that equal bodies meeting with unequal velocities, they will, after the stroke, both go on the same way which the most prevalent body moved before.

If the velocity $\frac{\mathrm{Q\,V} \pm Q\,V}{\mathrm{Q} + \mathrm{Q}}$ be multiplied by the quantities of matter Q and Q, we shall have $\frac{\mathrm{Q}^2\,\mathrm{V} \pm \mathrm{Q}\,Q\,V}{\mathrm{Q} + Q} =$ the momentum of A after the stroke; and $\frac{\mathrm{Q\,V}\,Q + Q^2\,V}{\mathrm{Q} + Q} =$ the momentum B: therefore $\mathrm{Q\,V} - \frac{\mathrm{Q}^2\,\mathrm{V} \pm \mathrm{Q}\,Q\,V}{\mathrm{Q} + Q} = \frac{\mathrm{Q}\,Q\,\mathrm{V} \pm Q\,Q\,V}{\mathrm{Q} + Q} = \frac{\mathrm{Q\,Q}}{\mathrm{Q} + Q} \times \overline{\mathrm{V} \pm \mathrm{V}} =$ the quantity of the motion lost in A after the stroke, and consequently is equal to what is gained in B, as may be shewn in the same manner.

But since a part of this expression (*viz.* $\frac{\mathrm{Q}\,Q}{\mathrm{Q} + Q}$) is constant, the loss of motion will ever be proportional to the other part $\mathrm{V} \pm V$. But this loss or change of motion in either body is the whole effect, and so measures the magnitude or energy of the stroke. Wherefore any two bodies, not elastic, strike each other with a stroke always proportionable to the sum of their velocities ($\mathrm{V} + V$) if they meet, or to the difference of their velocities ($\mathrm{V} - V$) if they tend the same way.

Hence, if one body (B) be at rest before the stroke, then $V - o$; and the magnitude of the stroke will be as V; that is, as the velocity of the moving body A; and not as the square of its velocity, as many philosophers were accustomed to maintain.

In bodies perfectly elastic, the restituent power or spring, by which the parts displaced by the stroke restore themselves to their first situation, is equal to the force impressed, because it produces an equal effect; therefore, in this sort of bodies, there is a power of action twice as great as in the former non-elastic bodies, for these bodies not only strike each other by impulse, but likewise by repulse, they always repelling each other after the stroke. But we have shewn that the force with which non-elastic bodies strike each other is as $\mathrm{V} \pm V$; therefore the re-action of elastic bodies is the same; that is, the velocity with which elastic bodies recede from each other, after the stroke, is equal to the velocity with which they approached each other before the stroke. Whence if x and y be the velocities of two bodies A and B, tending the same way, after the stroke, since $\mathrm{V} - V = y - x$, we have $x + \mathrm{V} - V = y$; whence the motion of A after the stroke will be $\mathrm{Q}\,x$ and that of B will be $Q\,x + Q\,\mathrm{V} - Q\,V$; and the sum of the motions before the stroke, *viz.* $\mathrm{Q}\,x + Q\,x + Q\,\mathrm{V} - \mathrm{Q\,V} = \mathrm{Q\,V} + Q\,V$. Whence by reducing the equation, it will be $\mathrm{Q}\,x + \mathrm{Q}\,x = \mathrm{Q\,V} - Q\,\mathrm{V} + 2\,Q\,V$; and $x = \frac{\mathrm{Q\,V} - Q\,\mathrm{V} + 2\,Q\,V}{\mathrm{Q} + Q} =$ the velocity of the body A.

Again, the velocity of B is $x + \mathrm{V} - V = \frac{\mathrm{Q\,V} - Q\,\mathrm{V} + 2\,Q\,V}{\mathrm{Q} + Q} + \mathrm{V} - V =$

$\frac{2\mathrm{QV} - \mathrm{Q}V + QV}{\mathrm{Q} + Q}$. Here we suppose the bodies tend the same way before the stroke; and it is evident, from the equation above, that so long as $\mathrm{QV} + 2QV$ is greater than QV, the velocity (x) of A after the stroke will be affirmative, or the body A will move the same way after the stroke as before; but when $Q\mathrm{V}$ is greater than $\mathrm{QV} + 2VQ$, the velocity (x) will be negative, or the body A will be reflected back.

If the body B be at rest, then $V = o$; and $x = \frac{\mathrm{QV} - Q\mathrm{V}}{\mathrm{Q} + Q}$, which shews the body A will go forwards or backwards, as QV is greater or lesser than QV, or A greater or lesser than B.

If $\mathrm{Q} = 3$, $Q = 2$, $\mathrm{V} = 10$, (fig. 5.) and $V = o$; then after the stroke the velocity of A will be $x = \frac{\mathrm{QV} - Q\mathrm{V}}{\mathrm{Q} + Q} = \frac{30-20}{5} = \frac{10}{5} = 2$, and the velocity of B will be $y = \frac{2\mathrm{QV}}{\mathrm{Q}+Q} = \frac{60}{5} = 12$. If the bodies are both in motion, and $V = 5$, the rest is the same as before; then $\frac{\mathrm{QV} - Q\mathrm{V} + 2QV}{\mathrm{Q} + Q} = 6 =$ velocity of A (fig. 6.) after the stroke, and $\frac{2\mathrm{QV} - \mathrm{Q}V + QV}{\mathrm{Q} + Q} = 11 =$ velocity of B after the stroke.

If the bodies A and B move towards contrary parts, or meet each other, then will the relative velocity, to which the force of the stroke is proportional, be $\mathrm{V} + V$; and so the velocities of A and B after the stroke will be x and $x + \mathrm{V} + V$; and so the motion of A will be $\mathrm{Q}x$ and $Qx + Q\mathrm{V} + QV$: the sum of these motions is $\mathrm{Q}x + Qx + Q\mathrm{V} + QV = \mathrm{QV} - QV =$ the motion towards the same part before the stroke. Whence we have $x = \frac{\mathrm{QV} - Q\mathrm{V} - 2QV}{\mathrm{Q} + Q}$ and therefore the velocity of B will be $\frac{\mathrm{QV} - Q\mathrm{V} - 2QV}{\mathrm{Q} + Q} + \mathrm{V} + V$ $\frac{2\mathrm{QV} = \mathrm{Q}V - QV}{\mathrm{Q} + Q}$.

If $\mathrm{QV} + 2QV$ be greater than QV, the motion of the body A will be backwards; otherwise it will go on forwards as before.

If $\mathrm{Q} = 3$, $Q = 2$, $\mathrm{V} = 10$, and $V = 5$; then will the velocity of A (fig. 7.) be $\frac{\mathrm{QV} - Q\mathrm{V} - 2QV}{\mathrm{Q} + Q} = \frac{-10}{5} = -2$, and so the body A will go back with two degrees of velocity The velocity of B, after the stroke, will be $\frac{2\mathrm{QV} + \mathrm{Q}V - QV}{\mathrm{Q} + Q} = 13$.

If the bodies are equal, that is, if $\mathrm{Q} = Q$, (fig. 8.) then $x = \frac{-2QV}{2Q} = -V$; which shews, that when equal bodies meet each other, they are reflected back with interchanged velocities; for in that case also the velocity of B becomes $\frac{2\mathrm{QV}}{2\mathrm{Q}} = \mathrm{V}$.

If the bodies are equal, and one of them at rest, as B (fig. 9.) then since $\mathrm{Q} + Q$, and $V = o$, we have the velocity of A after the stroke $x = o$; or the body A will abide at rest, and the velocity of B will be $= \mathrm{V}$, the velocity of A before the impulse, as appears by the example in the figure referred to.

If several bodies, B, C, D, E, F, (fig. 10.) are contiguous in a right line, and another equal body A strike B with any given velocity, it shall lose all its motion, or be quiescent after the stroke; the body B which receives it will communicate it to C, and C to D, and D to E, and E to F; and because action and re-action between the bodies B, C, D, E, are equal, as they were quiescent before, they must continue so; but the body F, having no other body to re-act upon it, has nothing to obstruct its motion; it will, therefore, move on with the same velocity which A had at first, because it has all the motion of A, and the same quantity of matter by hypothesis.

Let there be three bodies, A, B, C, (fig. 11.) and let A strike B at rest; the velocity generated in B by the stroke will be $y = \frac{2\mathrm{QV}}{\mathrm{Q}+Q}$, and so the momentum of B will be $\frac{2\mathrm{QV}Q}{\mathrm{Q}+Q} = Qy$. With this momentum B will strike C at rest and contiguous to it; the velocity generated in C will be $\frac{2Qy}{Q+C}$, and its momentum will be $\frac{2Qy\mathrm{C}}{Q+C} = \frac{2\mathrm{Q}\mathrm{C}}{Q+\mathrm{C}} \times \frac{2\mathrm{QV}}{\mathrm{Q}+Q} = \frac{4\mathrm{QV}\,Q\mathrm{C}}{\mathrm{Q}Q + \mathrm{QC} + Q^2 + QC}$.

If now we suppose B a variable quantity, while A and C remain the same, we shall find what proportion it must have to each of them, in order that the momentum of C may be a maximum, or the greatest possible, by putting the fluxion thereof equal to nothing; that is, $\frac{4\,\mathrm{Q}^2\mathrm{C}^2\mathrm{V}\,Q - 4\,\mathrm{QC}\,Q^2 Q}{\overline{\mathrm{QC}+\mathrm{Q}Q+Q\mathrm{C}+Q^2}|^2} = 0$; whence we get $\mathrm{QC} - QQ = 0$, and so $\mathrm{QC} = QQ$; consequently $\mathrm{Q} : Q :: Q : \mathrm{C}$, or $\mathrm{A} : \mathrm{B} :: \mathrm{B} : \mathrm{C}$; that is, the body B is a geometrical mean between A and C. Hence, if there be any number (n) of bodies in a geometrical ratio (r) to each other, and the first be A; the second will be $r\mathrm{A}$, the third $r^2\mathrm{A}$, and so on to the last, which will be $r^{n-1}\mathrm{A}$.

Also, the velocity of the first being V, that of the second will be $\frac{2\,\mathrm{V}}{1+r}$ (for $\frac{2\,\mathrm{Q}\,\mathrm{V}}{\mathrm{Q}+Q}$ is here $= \frac{2\,\mathrm{AV}}{\mathrm{A}+r\mathrm{A}} = \frac{2\,\mathrm{V}}{1+r}$); that of the third $\frac{4\,\mathrm{V}}{\overline{1+r}|^2}$ that of the fourth $\frac{8\,\mathrm{V}}{\overline{1+r}|^3}$, and so on to the last, which will be $\overline{\frac{2}{1+r}}|^{n-1}\,\mathrm{V}$.

The momentum of the first will be A V, that of the second $\frac{2r\,\mathrm{AV}}{1+r}$, that of the third $\frac{4\,r^2\,\mathrm{AV}}{\overline{1+r}|^2}$, that of the fourth $\frac{8\,r^3\,\mathrm{AV}}{\overline{1+r}|^3}$, and so on to the last, which will be $\overline{\frac{2\,r}{1+r}}|^{n-1}$ A V.

To give an example of this theorem: if $n = 100$, and $r = 2$, then will the first body A be the last r^{n-1} A, as 1 to 338253000000000000000000000000, nearly; and its velocity to that of the last nearly as 271022000000000000 to 1: lastly, the momentum of the first to that of the last will be nearly as 1 to 2338480000000.

If the number (n) of bodies be required, and the ratio of the momenta of the first and last be given as 1 to M, and the ratio of the series r given also; then, putting $\frac{2\,r}{1+r} = \mathrm{R}$, we have the momentum of the last body expressed by $\overline{\frac{2\,r}{1+r}}|^{n-1} = \mathrm{M} = \mathrm{R}^{n-1}$; therefore the logarithm of M ($l.\,\mathrm{M}$) is equal to the logarithm of R ($l.\,\mathrm{R}$) multiplied by the power $n-1$; that is $l.\,\mathrm{M} = n - 1 \times l.\,\mathrm{R}$; consequently, $\frac{l.\,\mathrm{M}}{l.\,\mathrm{R}} + 1 = n$, the number of bodies required.

Motion, in botany, implies not so much a change of place, as a change of direction. The direction of the roots and stems of the plants is totally opposite, the former either running directly downwards, or extending themselves transversely or horizontally under the surface of the earth: the latter exhibiting motions of a similar nature, but in a contrary direction. The direction of the root is never vertical, except in the sanar of Senegal, the roots of which twisting, rise vertically upwards a foot above the surface of the earth, and are sometimes covered by the flux of the sea. Familiar as the appearance is, naturalists are not agreed with respect to the causes which determine the roots of plants to tend universally downwards, either in a horizontal or perpendicular direction; and the stems, on the contrary, to mount perpendicularly or horizontally upwards. So constant, however, are these opposite directions, that a plant being taken out of the earth, and replanted in it in such a manner that the root is uppermost, and the stem lowermost, the root will quickly curve downwards, the stem upwards, till each has resumed the direction which is proper and natural to itself.

All the causes which concur in promoting the growth of plants appear likewise to operate in determining their direction. Such are, the air, the sun, light, and the moist warm vapours which arise out of the earth. The three first seem to concur most certainly to the direction of the stem; air and moisture to that of the root. If any number of plants are placed in pots, in a room which only admits the light by a single hole, the stems will incline or direct themselves towards that side. In thick forests, the young trees always lean to the side where the light penetrates. The new shoots of an espalier detach themselves from the wall which robs them of the air, the sun, and the light. It is in quest of the same excellent gifts of nature, that the lateral branches of trees, abandoning the direction of the stem, spread and extend themselves in a direction parallel to the soil, even when planted on a declivity. In like manner it appears, that the roots penetrate more or less deeply into the ground, either in a perpendicular or horizontal direction, in proportion to their greater or less tendency to search for moisture. Thus it is a well known fact, that, in the neighbourhood of canals, ditches filled with water, and, ground newly tilled, the roots of plants abandon their natural direction, and as it were, steer their course towards the fine air, rich juices, and grateful humidity, which their situation has placed within their reach. So strongly, indeed, are the roots of plants attracted by water, that they frequently relinquish the soil, and penetrate into the very heart of the ditches and canals. The force of extension appears to be greater in roots than in stems. The branch surmounts an obstacle by leaving its natural direction and over-topping it. The root, on the contrary, without once going out of its way, pierces the hardest soils, penetrates into walls, which it overturns, and even into rocks, which it bursts.

Although the natural motion of the trunk be to ascend, as was suggested above, yet is it forced sometimes to descend; for the trunk-roots growing out of some plants near the ground, and shrinking into it, serve, like so many ropes, to pluck the trunk annually lower and lower into the ground along with them. If these trunk-roots break out only about the bottom of the trunk, then it gradually descends into the earth, and is converted into a root, but if the trunk is very slender, and the trunk-roots break forth all along it, then it creeps horizontally: the trunk-roots in question tethering it, as it trails along, to the ground, as in strawberry, cinquefoil, and mint. It may be observed, that the direction of the roots and stems of plants seems to be regulated, in a great measure, by the vapours which they contain, but more by those which arise from the soil in which they grow; and that heat, the sun, or the light, the causes already suggested, appear to contribute to that direction, only in so far as they augment or regulate the current of these nourishing vapours.

Trunks are not, however, the only parts of plants which direct their course towards the air and the light of the sun. There are flowers which, quitting their perpendicular direction, present their surface directly to that luminous body, and follow its situation in its diurnal course. This sort of motion has been called, by some writers, nutation; and the plants which are subject to it, have been termed heliotropæ; that is, turning with the sun. Of this kind are bastard-rocket, dyer's-weed, sun-flower, turnsole, and the greatest part of the compound flowers with plain tongue-shaped petals. In these flowers, the disk or surface looks towards the east in the morning, the south at noon, and the west at night. The spikes or ears of corn, which hang down by their weight, are observed, in like manner, to incline themselves towards the sun, never to the north. The stems of draba, trientalis, and a species of bastard fever-few, with egg-shaped and notched leaves, incline or hang downwards during the night.

The observations of Hales and Bonnet establish, that these motions are occasioned, not by any twisting in the stem, but by the dryness of the fibres, which, by being exposed to the heat of the sun, contract, and thus determine the nutation of the flowers and young stems. It is in this manner that moisture and dryness alternately dilate and contract the plant improperly called the rose of Jericho; an appearance which is likely observed in the beards of oats, and in those of the capsules of crane's bill.

The direction of the leaves of several plants suffer considerable changes during the night. This is so certain, that if a botanist who is accustomed to the port or habit of plants were to examine, in a summer night, the plants which cover any particular meadow, he would find several which he could not recognize by that character. The same changes happen when the moisture of the day corresponds to that of the night.

The change of direction just mentioned is particularly sensible in compound leaves. During the heat of the sun in the day-time, the pinnated or winged leaves of several plants, particularly those of the pea-bloom or leguminous tribe, rise vertically upwards, and form a right angle with the common foot-stalk; the lobes, or lesser leaves, which stand opposite, being applied closely together by their upper surface. Several simple leaves, particularly those of sigesbecka, and Indian mallow, (urena) when their upper surface is exposed to an ardent sun, become, in like manner, concave; which demonstrates their analogy with the winged leaves just mentioned.

In that state of the atmosphere which generally precedes a storm, and in a close, moist, and cloudy air, the winged leaves extend themselves along the common foot-stalk. The same appearance is observed in the leaves of the sensitive plant, when it has been kept for several days in a cellar below ground. After sun-set, and during the fall of the dew, they incline still lower, hang vertically downwards, and are applied closely together, like the leaves of a book, by the lower surface, under the stalk with which they stand at right angles. The odd lobe, if there is one at the extremity of the leaf, folds itself up till it has reached the first pair of lobes or smaller leaves, in its neighbourhood. This motion, which Linnæus calls the sleep of plants, and can be produced by an artificial as well as natural dew, has been observed, not only in compound leaves, such as those of the pea-bloom plants, but likewise in some simple leaves, particularly those of balsam, and bastard fever-few. The small leaves of false acacia and liquorice hang downwards during the night, but are not united by the under surface, like the greater part of leguminous plants. Those of the sensitive plant, mimosa pudica, extend themselves longitudinally along the common foot-stalk, and infold one another mutually. The small lobes of several species of trefoil, lucerne, and lotus, are united only by their summits, and form a cavity, which contains the young flowers, and shelters them from cold and other injuries to which they are liable in the night-time. In some simple leaves, a similar appearance is observed. Thus the upper leaves of garden orach approach during the night, unite perpendicularly, embrace the young shoot, and do not relinquish that posture till the sun has dissipated the humidity of the air. See Milne's excellent Botanical Dictionary, to which we have been indebted for these observations.

Motion, *perpetual*, or **Movement**. See **Movement**.

MOTTO, in armoury, a short sentence or phrase carried in a scroll, generally under, but sometimes over, the arms; sometimes alluding to the bearing, sometimes to the name of the bearer, and sometimes containing whatever pleases the fancy of the deviser. The motto, or word, says Guillim, is an ornament annexed to coat-armour; being the invention or conceit of the bearer succinctly and significantly expressed, usually in three or four words, which are commonly set in some scroll or compartment, placed at the foot of the escutcheon. Our ancestors made choice of such mottoes as expressed their predominant passions, as of piety, love, war, &c. or some extraordinary adventure that had befallen them; most of which have become hereditary in several families. The motto of the royal family of England is, DIEU ET MON DROIT, *God and my right*; of the most noble order of the garter, HONI SOIT QUI MAL Y PENSE, *Evil be to him that evil thinks*; of the dukes of Norfolk, SOLA VIRTUS INVICTA, *Only virtue is invincible*; of the duke of Beaufort, MUTARE VEL TIMERE SPERNO, *I scorn to change or fear*; of the Marquis of Buckingham, TEMPLA QUAM DILECTA, *How beloved are thy temples*, in allusion to his name of Temple.

MOVEABLE, in general, denotes any thing capable of being moved. The moveable feasts are such as are not regularly held on the same day of the year or month, though they are always on the same day of the week. Thus Easter, which is that moveable feast on which all the rest depend, is held on the Sunday which falls upon, or next after, the first full moon following the 21st of March; and all the other feasts keep a regular and certain distance from it: such as Septuagesima, Sexagesima, Ash-wednesday, Ascension-day, &c. which see under their proper articles. The moveable terms are, Easter-term and Trinity-term.

MOVEMENT, in mechanics, a machine that is moved by clock-work. See **Clock**.

Movement, in military affairs. Under this term are comprehended all the different evolutions, marches, counter-marches, and manœuvres, which are made in tactics, for the purpose of retreating from, or of approaching towards, an enemy. It also includes the various dispositions which take place in pitching a camp, or arranging a line of battle. The science of military movements forms one of the principal features in the character of a great commander. If he be full of resources in this important branch, he may oftentimes defeat an enemy without even coming to blows: for to conceal one's movements requires great art and much ingenuity.

Movement, in music, the name given to any single strain, or to any part of a composition comprehended under the same measure or time. When any piece changes its time and measure, either from one species to another, or in the same species, it is then said to change its movement; so that every composition consists of as many movements as there are positive changes in the time or measure. See **Music**.

MOVING *plant*. See **Hedysarum**.

MOULD, or **Mold**, in the mechanic arts, &c. a cavity, cut with a design to give its form or impression to some softer matter applied therein, of great use in sculpture, foundery, &c. The workmen employed in melting the mineral or metallic glebe dug out of mines, have each their several moulds, to receive the melted metal as it comes out of the furnace; but these are different, according to the diversity of metals and works. In gold mines they have moulds for ingots: in silver mines, for bars; in copper and lead mines, for pigs and salmons, in tin mines, for pigs and ingots; and in iron mines, for saws, chimney-backs, anvils, cauldrons, pots, and other large utensils and merchandizes of iron, which are here cast as it were at first hand.

Moulds, in the manufacture of paper, are little frames, composed of several brass or iron wires, fastened together by another wire still finer. Each mould is of the bigness of the sheet of paper to be made, and has a rim or ledge of wood to which the wires are fastened; these moulds are more usually called frames, or forms.

Moulds *for leaden bullets*, are little iron pincers, each of whose branches terminates in an hemispherical concavity which, when shut, form an entire sphere: in the lips or sides where the branches meet is a little jet or hole, through which the melted lead is conveyed.

Moulds, *glazier's*. The glaziers have two kinds of moulds, both serving to cast their lead. In the one they cast the lead into long rods or canes fit to be drawn through the vice, and the grooves formed therein; this they sometimes call ingot-mould. In the other they mould those little pieces of lead a line thick, and two lines broad, fastened to the iron bars; these may be also cast in the vice.

Moulds, among plumbers, are the tables whereon they cast the sheets of lead. These they sometimes call simple tables; besides which they have other real moulds, wherewith they cast moulds without soldering.

Moulds, used in basket-making, are very simple, consisting ordinarily of a willow, or osier, turned or bent into an oval, circle, square, or other figure, according to the baskets, panniers, hampers, hats, and other utensils intended. On these moulds they make, or more properly measure, all their work, and accordingly they have them of all sizes, shapes, &c.

Moulds, among tallow-chandlers, are of two kinds; the first for the common dipped candles, being the vessel wherein the melted tallow is disposed, and the wick dipped; this is of wood, of a triangular form, and supported on one of its angles, so that it has an opening of near a foot at top; the other, used in the fabric of mould candles, is of brass, pewter, or tin; here each candle has its several moulds. See Candle.

Mould, among gold-beaters, a certain number of leaves of vellum, or pieces of guts, cut square, of a certain size, and laid over one another, between which they put the leaves of gold and silver which they beat on the marble with the hammer. They have four kinds of moulds, two whereof are of vellum, and two of gut; the smallest of those of vellum consists of forty or fifty leaves, the largest contains an hundred; for the others, each contains five hundred leaves. The moulds have all their several cases, consisting of two pieces of parchment, serving to keep the leaves of the mould in their place, and prevent their being disordered in beating.

Mould, in agriculture, a loose kind of earth, every where obvious on the surface of the ground, called also natural or mother-earth; by some also loam.

MOULDINESS, a term applied to bodies which corrupt in the air from some hidden principle of humidity therein; and whose corruption shows itself by a certain white down, or lanugo, on their surface, which, viewed through a microscope, appears like a kind of meadow, out of which arise herbs and flowers, some only in the bud, others full blown, and others decayed, each having its root, stalk, and other parts.

MOULDING, any thing cast in a mould, or that seems to have been so, though in reality it were cut with a chisel, or the ax.

Mouldings, in architecture, are formed by plane and curved surfaces, and their names determined by the outline of their right angular section, together with their situation in the building.

They generally consist in a combination of annular solids, sections of the circle, elliptical and hyperbolical curves.

MOUNTAINS, stupendous elevations of earth and other substances, in some cases coeval with creation, and in others the produce of subterraneous motion, caused by fire and confined vapours.

The methods used to ascertain the heights of mountains, are necessarily imperfect, as their pyramidal outline uniformly prevents the dropping of a plummet, the only certain mode of accurate measurement. Before the invention of the instruments now employed for this purpose, which undoubtedly approach very nearly to certainty in their result, recourse was had to conjecture, and the erroneous practice of measuring their shadows. Strabo, judging from the means possessed in his time, declared the highest mountain in the world to be equal to 21,830 English feet. Kircher, deciding from the length of their shadows, pronounced

Ætna - - - - - - - - - - -	25,600
The Peak of Teneriffe - - -	64,000
Mount Athos - - - - - - -	128,000
And Larissa in Egypt - - -	179,200

M. Bourrit, who explored the Alps, gives the following table of the various elevations of places and mountains above the level of the sea.

	English yards.
The Lake of Geneva, at the lower passage of the Rhone - - -	398
The Lake of Neufchatel - - -	456
Highest point of the needle of Saleve - - - - - - - - - - -	1488
Summit of Canigou - - - - - -	3088
Summit of Dole, the highest mountain of Jura - - - - - - - -	1800
Summit of Mole - - - - - - -	2014
Valley of Chamouni - - - - - -	1151
Ridge of Breven - - - - - - -	2949
Valley of Montanvert - - - - -	1865
Abbey of Sixt - - - - - - - -	797
Granges des Communes - - -	1769
Highest Grange of Fonds - - -	1458
Summit of Grenier - - - - - -	2782
Summit of Grenairon - - - - -	2958
Plain de Lechaud - - - - - -	2295
Summit of Buet - - - - - - -	3315
Mont Blanc - - - - - - - - -	5081
Mount Ætna - - - - - - - -	4000
Summit of the Table at the Cape of Good Hope - - - - - - -	1153
Summit of Snowdon in Wales - -	1224
Pike Rucco in the island of Madeira	1689
Pike of Teneriffe - - - - - - -	4399
The same, according to Dr. Heberden - - - - - - - - - - -	5132
Summit of Cotopaxi according to Ulloa - - - - - - - - - - -	6643

Some philosophers have estimated the Peak of Teneriffe to be 19,200 feet in height; Feuille reduces it to 13,248; and others assert that the Peak and Ætna are the most elevated objects on the earth. But this supposition has been combatted by Sir George Shuckburgh, who measured Ætna from an observation by M. de Saussure, and found it to be 10,954 feet above the level of the sea. The latter gentleman had obtained the height of Vesuvius, and Sir George measured Mont Blanc: from which it appears that the height of Vesuvius added to that of Ætna is 14,854 feet, and that of Mont Blanc alone amounts to 15,662 feet; whence he infers, that Mont Blanc far eclipses all other mountains in Europe, Asia, and Africa; those of America, according to Condamine, are of vast height, and in some instances the elevation amounts to 19,200 feet.

Upon comparing the calculations of different persons in their attempts to measure these enormous masses, it will be found that they vary greatly; it is therefore obvious, that the methods at present in use are subject to impediments, which are attributable to many causes: some of those may hereafter be removed, but there are others so completely connected with local circumstances of heat, cold, moisture, and the reverse, that it is impossible they should ever be overcome; neither is it quite correct to infer that the chain of the Caucasus, the Taurus, and the African mountains, are inferior to Mont Blanc, unless the same opportunities were afforded for measuring their heights which exist in Europe. Mr. Coxe says, "conjectures are now banished from natural philosophy; and until it shall be proved from undoubted calculations that the highest part of the Caucasus rises more than 15,000 feet above the level of the sea, Mont Blanc may be fairly considered as more elevated." This position rests on very slender grounds indeed, and, resembling the conjectures said to be banished from natural philosophy, it should be rejected without hesitation. In truth, this point will most probably never be satisfactorily adjusted, and we must rest satisfied with the knowledge we have already acquired, till reason or philosophy shall have taught, or extended civilization throughout the globe, and future naturalists have made measurements of hitherto unexplored mountains, with instruments similar to those used by Saussure and Shuckburgh.

There are numerous and serious obstacles opposed to the ascertaining of the nature of the substances which compose the great mass or internal structure of mountains, but every thing has been done which art and perseverance will permit. M. Arduini, a gentleman of strong abilities and indefatigable research, exerted every means in his power some years past to obtain a knowledge of the interior state of the Vicentine and Veronese hills, which he divides into *montes primarios*, *secundarios*, and *tertiarios*.

The *montes primarios* is a vast body of slate, extending under the calcareous hills, which he concludes existed prior to their origin.

The *montes secundarios* are large calcareous hills formed into strata, composed of a close impalpable limestone, and interspersed with marine petrifactions, similar to parts of the Alps, and the chain of mountains which separate Germany from Italy.

Montes tertiarios, are the lower hills, consisting of small beds of limestone, abounding with petrifactions, and with casual interventions of sand and clay, but are of a later origin, since incumbent on the "montes secundarios," and produced by their decay, variously washed down and accumulated together.

The slate of the first division is argillaceous, containing micaceous particles of the colour of silver, is crossed by veins of quartz, lamellated, and often appears in waved strata. It extends to the greatest depth of any rock in the neighbourhood, and has never been cut through, from which circumstance it cannot be decided whether granite extends beneath it, as is usual in other mountainous countries, "though this be very probable," says Ferber, "since the granite rocks appear from under ground in the higher Alps of Tyrol, and the grey granite, or granitello, is to be found near Tozzino and Primiero, at the spring of the river Cismonoe, which falls into Brenta.

The calcareous Alps consist of strata of a close impalpable grain, with little mixture of saline matter and petrifactions. The deepest stratum of limestone from the base to the middle of the hill is composed of numerous small masses, and the exterior being subject to the action of rain-water, it is formed into chasms, leaving the intervals in elevations of a dark lead-colour; the petrifactions scattered through it are small bivalves and rifled tellines. The next stratum is inconsiderable, but a better white, more solid, and serves for architectural purposes; the upper part contains no petrifactions, the lower has some unknown ostracites. The third stratum is in many small beds, in some instances furnishing sea-shells, and in others destitute of petrifactions. The part connected with the fourth stratum consists of oolithes. The fourth stratum is composed of several smaller, which are either red, containing ammonites, of very considerable size, or completely white, with petrifactions or ammonites. The red Veronese marble, abounding with ammonites, is procured from this stratum. The fifth division consists of an infinite variety of beds of white limestone, those in the highest mountains, particularly Monte Torraro, contain no marine productions, but the rest abound with various, each stratum being filled with a peculiar species. The surfaces of these Alps on the summits is called scaglia, by the Italians, and consists of a calcareous bed, in some parts containing nodules, and in others, less extensive, numerous flints of various colours. Covering the mountains, it declines under the Montes Tertiarios Bericos, and ascends on the opposite side to the volcanic hills, by the sides of which it appears to have been raised, and then broken. The scaglia is destroyed in many different places by the weather, and is only to be found in a perfect state in the valleys and cavities. M. Arduini discovered red flints, branching like coral, in the scaglia of Monte di S. Pancrazio, and that spread on the volcanic hills near Padua is perforated by sulphurous hot wells.

The several strata of the hills or mountains in question have been originally disposed in an horizontal direction, but those are deranged, and broken into large fissures by the force of volcanic eruptions and earthquakes, through which lavas were ejected, consequently they are sunk in some places, in others wholly reversed, and sometimes they are found oblique, and even vertical. Inundations, and the obstructions of the course of rivers, caused by the above means, have also operated to produce many changes, which are particularly conspicuous at Ayorth, in Valle Imperina. The fields near Gallio, Asiago, Campo di Rivere, &c. situated on the mountains far above the level of the sea, are strewed with vast numbers of separate fragments of granite, quartz, and other vein-rocks, which appear to have been detached by violence from the primitive mountains of Tyrol. Similar pieces are found on the same horizontal elevation in Feltrino, separated by the Brenta from the others, and westward on the same heights from Astico to the river Adige. Their number and variety of bulk is remarkable at Tonezza, and near Folgaria, where the hills being entirely calcareous, entirely destitute of sound and primitive strata, demonstrate that the fragments alluded to are foreign to the places in which they are deposited. As no possible movement of water could, in the nature of things, be supposed to elevate these masses, it is equally fair to suppose, that streams gushing down the mountains have carried them to their present situations, from those vast ruptures observable in every direction on mountains, doubtlessly caused, in the first instance, by earthquakes, filling the usual channels of great bodies of water.

The calcareous portion contains numbers of natural caverns, incrustated with stalactites, and some veins of metal, which are neither large nor extensive, but cross the compact limestone in the under stratum, being invariably inserted in the fissures next to the adjoining inferior slate and its metallic veins, to which they appear to belong, and the cracks of the solid limestone, into which volcanic matter has been forced, sometimes contain metals. Generally, no ore or veins are discoverable in the highest stratum of the calcareous mountains which are lamellated and shiver. The ancient silver mines in Monte di S. Catharina, in Tretto, pass through the undermost compact limestone; and in Monte di Trisa, Monte Narro, Monte di Castello di Pieve, and several others to the west, are veins and old mines of silver, copper-ore, and lead, with pyrites, manganese, and bland, which extend through limestone. In Monte Sivelina is hard limestone, without visible stratum, petrifactions, a lead vein, coarse tessilated lime-spar, manganese, and amethysts.

The last division, "montes tertiarios," or lower hills, were in some degree produced by the decay of the higher, and accumulations of sand and clay: those have regular strata, and various petrifactions, and particularly nummularios and lenticularios. They have suffered great derangement from volcanic causes, which is demonstrated by the discovery of large fragments of limestones, petrifactions, and other substances, inclosed by the lava, and raised by its flowing upward, and they have often been covered by the descent of ashes. Some are considered as posterior to the eruptions, and rest on their productions; when those are found to contain pieces of lava, or pumice stone, it is conjectured that they have been introduced by the passage of water. Several of these hills in the Vicentine, Veronese, and other districts of the Venetian territories, contain strata of coal, which inclose some petrifactions, particularly a fish found at Monte Viale, in the first mentioned district. Very little ore has been discovered; and Ferber, to whom we are indebted for those observations, was at a loss, whether to class certain sandy and argillaceous hills in the Valle di Signori with those under consideration, as the latter contain coals, plaster, alabaster, sulphureous pyrites, with some lead, copper, and iron ore.

Many of the hills in the Vicentine and Veronese districts furnish numerous and beautiful petrifactions: of these the Montes Berici, near Vicenza, are most remarkable. Creazzo, three miles from Vicenza, contains the inner nuclei or impressions of Chamites, almost perfect pectinites, the arca Noæ, the chitos Linnei, and some scarce glossopetras, and the sand abounds with fragments of madrepores, small nautilites, and uncommon teeth of fish. I. Colli di Montecchio e Castel Gomberto is full of petrifactions, and the lowest explored stratum of Brendola, ten miles from Vicenza, is a blue clay, interspersed with surprising quantities of marine bodies, and is covered by numbers of limestone beds, dipping towards the sea, including a great variety of sea shells, but unlike those contained in the clay. The west side of the hill is covered with lava, generally striated, and formed like sherl. The fissure in the lava, called *le spesse*, has a rivulet in the bottom, which flows over ground, containing an astonishing quantity of madrepores, fungites, and exotic shells, the aggregate affording a most pleasing assemblage of marine and volcanic productions. Ostracites are found very plentiful at St. Vido, and at Gramona are petrified echinites, and the echinus orbiculus, which inhabits the Indian seas in its natural state. Besides these, there are serpula lumbricalis; and at one hundred yards distance nummularii, and non-descript balani. An isolated hill, called Favourita, in the Vicentine district, contained the bones and teeth of a crocodile, discovered by M. Arduini. Ronca seems to be the production of the united powers of Neptune and Vulcan; but the interior is in a state of utter confusion and devastation; the summit is completely volcanic and without petrifactions; beneath are calcareous beds, which have petrified bivalves, nummularii, and turbinites; still lower is a mass of black lava, hard and broken in small fragments, nearly of an angulated prismatical form; after which red clay or marle, mixed with petrifactions, occurs; then lava, pumice stone, breccia, or limestones, inserted in lava, and beds of limestone, with petrifactions. Ronca affords plenty of ostracites of different species, and in good preservation, murices, anomiæ, and bones; the species amount to thirty; those are found in the calcareous strata, and in the volcanic sand and ashes, which, coagulated with limestones, have produced a species of breccia.

It has been judged necessary to dwell on the discoveries made as to the internal formation of the above hills, as their size and situation enable the curious investigator to accomplish his wishes: and as the information thus obtained must be accepted in place of facts, in relation to the stupendous mountains to be noticed hereafter in this article; those defy the labours of the philosopher, who is compelled to creep along their craggy and forbidding sides, attentive to his own safety, rather than their properties, and to conjecture the internal state from external appearance.

Ferber says, the island of Elba is remarkable, on account of its iron-mines, the mountains of which consist of granite, generally of a violet colour and very fine, as the feld-spath lies in large oblong cubes of the above tint. The ore is not found in veins, but in an enormous mass surrounded by the mountains of granite; it is besides a fact, that several mountains in Sweden, Lapland, and Siberia, wholly consist of iron-ore; and some hills in Campiglia, and other places in Tuscany, are either entirely, or in a great measure, of the same nature.

Further particulars of the probable contents of mountains in other parts of the globe will be found as we proceed in this investigation, but it will next be necessary to mention the changes observable in the state of the atmosphere by those who have ascended to the summits of the highest portions of our earth; several attempts have been made to attain the most elevated points of Mont Blanc by the guides of Chamouny, and by Messrs. de Saussure and Bourrit; the first undertaken by the guides was on the 13th of July, 1776, when three of them accompanied by M. Couteran departed from the Priory, at some distance from the mountain, at eleven in the night; those persons passed through the interval between the glaciers of Bosson and Tacono, and were fourteen hours employed in ascending a most rugged way, crossing extensive vallies of ice, and plains of snow, before they reached the vast elevation opposite to Mont Blanc, which then appeared as if very near them, but on a more attentive examination of the relative situation of the places, they found they had been deceived by the clearness of the air, and the brightness of the snow, and that it would require at least four hours of additional exertion to reach the summit, which they considered impracticable for many reasons, and particularly as the clouds gathered on the sides of the mountain, and threatened a tempest; they therefore returned with precipitation, which had nearly been fatal to one of the party, who, in leaping over a chasm in the ice, slipped and fell into it, but fortunately retaining his grasp of the pole with which he performed the spring, and that falling across the chasm, he was extricated by his companions; the man fainted, and remained insensible for some time, but they reached Chamouny without further accident, after twenty-two hours of incessant labour. Sir George Shuckburgh calculated that they had attained the height of 13,000 feet above the level of the Mediterranean Sea.

The failure of this arduous undertaking discouraged other attempts for some years, and till M. Bourrit prevailed upon six guides to accompany him on September 11th, 1784; this gentleman pursued his journey with great ardour and enthusiasm, but was arrested in his progress by the intenseness of the cold, which compelled him to return; the guides were less affected, and two that had preceded the rest reached the dome of Goute, situated about 9,400 feet in a horizontal direction from the summit. On the fourth of September, in the following year, Marie Contet and James Lambat ascended to a great height, and passed the night under the shelter of a rock; advancing with the dawn of day, they reached the dome, just mentioned, about seven o'clock, and would have proceeded, with every prospect of success, had not a dreadful storm of hail rendered further exertion impracticable.

On the 18th of September, the same year, Messieurs de Saussure and Bourrit, and twelve guides, bearing a variety of instruments intended for observations, left Bionsay, and after some time arrived at a hut which they had ordered to be constructed at Pierre Ronde, 7,808 feet above the level of the sea; they passed the night at this uncomfortable elevation, and proceeding in the morning, they reached the hitherto decided boundary of research, the dome of Goute; there a fresh fall of snow lay in so great a depth, as to prevent the possibility of wading through it, and the party returned. M. de Saussure imagined he had ascended to 8,256 English feet, and he found that the barometer sunk eighteen inches and a half. The guides, those hardy sons of the Alps, were not deterred by the hard-ships endured on these occasions, and six once more entered upon an unsuccessful ascent in July, 1786; James Balma, a young man of great strength, and possessed of an excellent constitution, one of the number, having missed his way in wandering upon the ice, was under the necessity of passing the night on a spot above the dome; this he accomplished in safety, and in the morning he had the resolution to examine the mountain, in order to ascertain whether a more favourable path might not be discovered for ascending on any future occasion; the result was according to his wishes, and he descended to Chamouny without accident, where he was afflicted with a very severe indisposition, the united effects of extreme cold and fatigue; Dr. Paccard, a resident physician, attended Balma during his illness, to whom he related his observations on the practicability of ascending Mont Blanc, and offered to attend him on his recovery, as a mark of gratitude for that event. Paccard, inspired by the hope of performing a task not hitherto accomplished, accepted the proposal, and they departed from Chamouny on the 7th of August; they reached La Cote before dark, and passed the night there; at three the following morning they recommenced their dangerous excursion, ascended to the dome of Goute, and at length arrived on the ridge of rocks seen from Geneva on the left of the summit; when there, the cold became almost intolerable, and their fatigue was such, that Paccard was inclined to return; but Balma encouraging him by example and persuasion, he followed the courageous guide, each walking sideways, to avoid, as much as possible, the piercing effect of the wind; at six in the evening they accomplished their wishes, and stood with triumph on a pinnacle never before visited by man; they remained half an hour on the summit, exposed to a degree of cold which froze the provisions they carried in their pockets, and the ink in their inkhorns. The difficulties of descending were almost as considerable as those they experiencd in the ascent, but they returned to Chamouny without any other unpleasant occurrence than blistered faces, swelled lips, and eyes injured by the brilliancy of the snow.

M. de Saussure, determined to follow this successful example, hired eighteen guides, provided a tent, mattresses, philosophical instruments, and provisions, and left Chamouny to ascend to the summit of Mont Blanc on the 13th of August, 1787. In order to render their expedition as safe and comfortable as the nature of it would permit, he had the precaution to have a hut constructed on La Cote, where the party passed the first night; by four o'clock in the afternoon of the following day they had ascended 12,762 feet above the level of the sea, and at that vast elevation they excavated a hut in the frozen snow, which they covered with a tent; in this they regaled themselves as well as they could, but M. de Saussure found the heat of the place so excessive, that he was frequently obliged to leave it, to recover from the debility and suffocation he experienced; at seven o'clock the next morning the party proceeded on their enterprize, and at eleven they reached the object of their hopes, the top of the mountain; there, lost in wonder and admiration at the variety and extent of the view on every side, this adventurous band remained three hours and a half, during which time they did not experience that extremity of cold felt by Dr. Paccard and his companion.

M. de Saussure, pursuing his intentions with that sagacity and method that distinguishes the genuine philosopher, had stationed M. Senebier at Geneva, who made similar experiments in that city at the same moment that the former was employed on Mont Blanc; by these means he found, that at Geneva, Reaumur's thermometer stood at 22.6 or 82 of Fahrenheit's, and on the mountain in the shade at $2\frac{3}{10}$ below the freezing point of the former, or 27 of the latter, a difference of 45 degrees by Fahrenheit. De Luc's barometer, when on the mountain, fell to $16.0\frac{144}{180}$, and at Geneva it stood at $27.2\frac{1085}{1600}$; and by making experiments with the same instrument, he calculated that the spot on which he made them was 15,662 feet above the level of the sea, agreeing almost exactly with the amount ascertained by Sir George Shuckburgh. The hygrometer evinced, that the air surrounding the summit contained six times less humidity than that of Geneva, to which cause he ascribed an excessive thirst, experienced by himself and the rest of the party, who were all more or less affected by the rarefaction of the air. The balls of the electrometer diverged three lines, and the electricity was positive on this enormous mountain, the most elevated rocks of which are granite, where M. de Saussure found at 11,392 feet from the sea, the moss-campion in bloom, and still higher the lichen sulphurens, and lichen rupestris; and what was a greater object of astonishment, two butterflies hovering near the summit.

Such was the result of M. de Saussure's labours, to which we shall add, in the words of Mr. Coxe, the following interesting facts, derived from Friar Francis, one of the monks resident at the priory at St. Gothard. "About four years ago the Elector of Bavaria sent to the friar several barometers, thermometers, and other meteorological instruments, which has enabled him to note the variations of the atmosphere, and to form a series of observations, of which he favoured me with the following result. In the most extreme cold he ever experienced in these parts, the mercury in Reaumur's thermometer fell to 19 degrees below the freezing point, or 10 of Fahrenheit. In 1784, greatest heat on the 13th of September, it stood at 13, or 61½ of Fahrenheit; greatest cold at 17°, or 8½° of Fahrenheit.

M. de Luc's barometer never
rose higher than . . . 22 3 1
Or fell lower than . . . 20 9 9

It appeared from observations made in 1784, that the average state of the thermometer and barometer was as follows:

	Thermometer.		Barometer.		
Nine in the morning	$2\frac{1}{16}$ of Reaumur,	or 28° of Fahrenheit . .	21	9	2
Mid day . .	0	or 32°	21	9	3
Nine in the afternoon	1—3 lines, . .	or 29½	21	9	4

In the same year it snowed during some part of 118 days; rained, 78; cloudy, 293; tempest, with hail, 12; thunder and lightning, 22; rainbow, 4; halos round the sun, 2; and round the moon, 2; serene days, 87."

Some particulars have been collected relating to the formation of the Alps, from which it appears, that granite constitutes their basis; large portions of this substance are scattered in the valleys near them, detached by different causes, and conveyed to very considerable distances by their weight; many dreadful consequences have followed the sudden separation of vast masses, of which two instances may be mentioned that are calculated to excite the utmost horror. Plurs, a town containing 1500 inhabitants, three churches, and situated on the Maira, was overwhelmed on the 25th of August, 1618, by the fall of part of a mountain, which was suspended in dreadful majesty above it, and in one moment for ever obliterated from the surface of the earth. A cloud of dust of impenetrable gloom pointed out to the survivors where the town had stood, and the cause of its ruin, as the enormous fragments of stone rushing with inconceivable rapidity through the air were ground into powder, where their sides met in collision with others; and had any of the miserable residents escaped the crush of their habitation, suffocation must have terminated their existence. Houses, vineyards, and large trees, now cover the ruins of Plurs, and bones and various utensils are casually discovered in digging.

On the 2d of September, 1806, and at five o'clock in the evening, the summit of Mount Rosenberg, generally called the Knippenouhl rock, separated from the adjoining parts, and fell to the base, which was situated in the valley that divides the lake of Zug from Lauwertz. One fragment rushed into the lake of the last named place, and caused a vast wave, which, flowing impetuously on the opposite shore, washed down a considerable number of houses, places of worship, and mills. Besides the loss thus occasioned by the lake, the earth and rocks levelled the villages of Goldau, Rothen, Busingen, and Kuzlock, containing in the whole above three hundred habitations. Upon inquiry it was found that 1000 persons had lost their lives by this suddden disruption of the mountain, which might have been less calamitous in its consequences, had the prediction of General Pfiffer been attended to, who, having made a model of the Alps, was well acquainted with the part under notice, and foresaw that it must be detached from its situation at no very distant period. It is generally supposed that the rock fell into a gulph, made by a large body of water which descended beneath it, and gradually undermined its support, and, turning by its super-incumbent weight, scattered into large portions, by striking on the projections in its progress, till reaching the plain, it is now said to cover a space of very great extent, and above 100 feet in height.

Mr. Coxe endeavoured to ascertain the component part of the Alps, and, to accomplish his purpose, wished to penetrate towards the chains of granite, through avenues of tremendous rocks, but found that the approach to it was equally difficult and dangerous, caused by the interposition of high secondary mountains, which conceal the primitive bed of granite, particularly in the vale of Lanterbrunnin, bounded to the extremity by calcareous rocks; the first masses of granite he discovered were at Sichellanen, forming the base of the rocks just mentioned; proceeding, he observed a rock of steatite, containing veins of lead, which have been worked at Hohalp; at a greater ascent is the true chain of granite, with scattered calcareous peaks; the approach was less difficult at Wengenalp, the last of several calcareous and schistous mountains, which join the Jungfrau, appearing to have summits of granite. Calcareous stone and argillaceous schistus form the vale of Grindenwald; and the surfaces of the Eger, the Mettenburg, and of the Wetterhorn, are chiefly calcareous, and cover the granite. The chains opposite, forming the north side of the valley of Grindenwald, consist of an argillaceous base, interspered with cornua ammones, and is covered by calcareous rocks.

In the further pursuit of his survey, Mr. Coxe considered the Jungfrau, or virgin, the centre of the primitive chain, which is one of the most grand and highest mountains in the canton of Berne; the lowest part of this elevated mass is generally covered with staldenflub, or rocks of calcareous stone, but the granite doth not appear for a considerable distance up the sides; at Sichellaninen, he observed a red stratum, composed of an argillaceous slate spotted with green and brown, and of a fine grained iron-ore containing anomites, which appeared to form the separation between the calcareous substance and the granite, a similar stratum was discoverable in other places, but at inaccessible heights; the same cause prevented the investigation in the chain extending to the right, and several peaks furnish no other means of judging of their structure, than fragments afford which have fallen from them; limestone occurs at a great elevation, and white and grey marble, serving as the matrix of a red hematite, abounding with small octagon crystals of iron, which may be attracted by the magnet. The glaciers of Breitlaninen and Breithorn support fragments of several species of granite, of iron-stone, of saxum fornacum or stelstein, and of argillaceous and micaceous schistus. "The ridge of the glacier of Gamchi is of a black calcareous stone, which, in many places, is of a fine texture, and splits into lamina of a rhomboidal form; in other parts it is coarsely granulated, containing white and black spar." Black slate forms the sides of the Blumlis Alp which fronts the glacier; this substance contains balemnites, and cornua ammonis, and the broken pieces of granite lying upon the glacier, fallen probably from the summit, resembles that before mentioned containing lead. The chain of granite extending to the right by the Alpschelenhorn and the Altits are lost in Mount Gemmi, where slate and calcareous stone alone are found. On the other side of the Jungfrau are two vast pyramids, called the interior and exterior Egers; on those, calcareous stone is visible to a great height, and Mr. Coxe was convinced that their substance is granite, though covered by calcareous stone, lying on slate of a reddish colour, forming in many places a species of brescia, with an argillaceous base, strewed with calcareous fragments; stones which have fallen from a ridge behind the exterior Eger on the inferior glacier of Grindenwald, prove that the summit is of granite, in blocks, veined granite, and other lamellated rocks, which frequently contain green steatites, amianthus, and crystals of quartz. The Schreckhorn, or peak of terror, has piked summits rising to an amazing height, which appear to be pure granite, and other primitive stones; the Wetterhorn, or stormy peak, is of calcareous stone for a great height, but the summits are certainly primitive rocks. Mr. C. observed the red stratum which he had noticed before on the Egea, and at the base of the Jungfrau. Behind the Wetterhorn is a large rock, the stones detached from which are frequently found to be veined granite and lamellated rock, enclosing pieces of the corneous spathosus, interspersed with steatites, pyrites and quartz. A quarry of beautiful white marble, veined with green, red, and yellow, was formerly worked at the foot of the Wetterhorn, but it has since been covered by the inferior glacier. The Scheidek consists entirely of black slate, which continues to compose the chain that divides Grindelwald from the plains of Hasli and the lake of Brientz. Mr. Coxe concludes his interesting observations in the following words. "As I descended the Scheidek, I observed on my right hand, the chain that joins the Wetterhorn, and runs towards the Grimsel. As I have not particularly examined this chain, I shall only remark, in general, that from an investigation of the stones and fragments which strew the vallies and sides of the hills, it appears to contain the same species of marble which I found on the superior glacier of Grindelwald, also red slate, argillaceous brescia, and various granites. But thus much is certain, that the front of these mountains is entirely concealed by secondary substances; and that the true region of granite was not apparent, until I had passed Myringen, and ascended the Grimsel, during the greater part of which ascent, I only noticed lamellated rocks and granite. This is the true region of granite, and other primitive rocks, the heart of the central chain, and the great observatory of the naturalist."

It is vain to think of entering into an examination of the various peculiarities of the stupendous mountains, which extend in every direction throughout the explored surface of our globe; we shall therefore confine ourselves to one other chain, from which, and what has previously been said, a tolerable conception may be formed of those grand and sublime objects, the admiration of each generation, from the hour of creation to the present moment.

The Atlas is an extensive chain, forming a crescent across the empire of Morocco, nearly from the north to the south, the northern extremity reaching to the Straights of Gibraltar. They are intersected by deep vallies, and distinguished by the names of the Greater and Lesser Atlas; their height is very great, and particularly near the city of Morocco, where, although situated so far to the south, their summits are perpetually covered with snow. The difficulty attending the exploration of the country, has hitherto repressed the curiosity of the philosopher, who would meet with little respect from the natives, and probably a summary fate, through the despotism of the government; under these circumstances we are compelled to receive casual information instead of philosophical certainty, and to adopt as fact what might perhaps on examination prove mere conjecture or misinformation; such may be the assertion, that the cold on the summits is fatal to animal life, as it is said certain Brebes who attempted to ascend the Atlas, died on the spot. These mountains abound with curious plants, well worth the attention of botanists; and it is further asserted, that they contain gold, and plenty of iron-ore, and that part of the chain is volcanic. Mr. Lempriere, who crossed the Atlas in December 1790, observes, "on the upper parts, in some places, there was nothing to be seen but an huge mass of barren and rugged rocks, whose perpendicular and immense heights formed precipices, which, upon looking down filled the mind with inexpressible horror; in others, we passed through thick and extensive forests of the arga tree, which, though it afforded an agreeable variety, being the only vegetable on the mountains, very little lessened the general appearance of barrenness. It is by no means a very easy matter to describe the different sensations which are experienced in passing over these wonderful mountains. Their immense height, the dangerous precipices, the vales, which, from their depth appeared like so many abysses, inspired altogether an emotion of awe and terror, which may be better conceived than expressed. On the other hand, the unlimited and great variety of prospects discoverable from their summits; the numerous herds of goats and sheep which were scrambling over the almost perpendicular cliffs; and the universal barrenness of the mountains, contrasted with the beautiful verdure of the vallies immediately below; formed on the whole a scene sufficiently beautiful and picturesque, to counterbalance the inconveniences we otherwise suffered."

MOUSE. See MUS.

MOUTH, in anatomy, a part of the face, consisting of the lips, the gums, the insides of the cheeks, the palate, the salival glands, the os hyoides, the uvula, and the tonsils. See ANATOMY.

MUCILAGE, in chemistry, is contained in the roots and leaves of a great number of plants. Almost all the bulbous roots and fleshy leaves yield it. The bulbs of the hyacinth contain so much, that when dried they may be employed as a substitute for gum-arabic. See GUM. Mucilage is sometimes found nearly pure, exuding from the bark and twigs of many vegetables, and hardening in the sun into brittle and almost transparent lumps.

MUCUS, a mucilaginous liquor, separated by the mucous glands and the nostrils.

MUCUS. See PHYSIOLOGY. The chemical properties of this substance are, that it has the appearance of gum arabic, only more opaque; it does not dissolve in alcohol or ether; it does not coagulate when heated; it is not precipitated by the oxymuriate of mercury, nor by the infusion of galls; the acetate of lead occasions a copious white precipitate when dropped into solutions containing mucus; so does the nitrate of silver. It is generally combined with gelatine and albumen, and always with some of the salts, and on the whole it is one of the least abundant of the animal fluids. In its natural state it is generally colourless, but from peculiar causes it will frequently assume a thick consistence and whitish colour like pus. From some experiments made by the late Dr. Charles Darwin, certain important conclusions have been drawn, for which the reader is referred to MEDICINE.

MUFFLE, in metallurgy, an arched cover, resisting the strongest fire, and made to be placed over coppels and tests in the operations of assaying, to preserve them from the falling of coals and ashes into them; though, at the same time, of such a form as is no hindrance to the action of the air and fire on the metal, nor to the inspection of the assayer. The muffles may be made of any form, providing they have these conditions; but those used with coppels are commonly made semi-cylindrical: or, when greater vessels are employed, in the form of a hollow hemisphere. The muffle must have holes, that the assayer may look in; and the fore part of it must be always quite open, that the air may act better in conjunction with the fire, and be incessantly renewed; the apertures in the muffle serve also for the regimen of the fire; for the cold air, rushing into the large opening before, cools the bodies in the vessels; but if some coals are put in it, and its aperture before be then shut, with a door fitted to it, the fire will be increased to the highest degree, much more quickly than it can be by the breathing holes of the furnace. See ASSAYING.

MUGIL, the *mullet*, in natural history, a genus of fishes of the order Abdominales. Generic character: lips membranaceous, the lower one carinated inwards; no teeth; above the corners of the mouth an inflected callous substance; gill-membrane with seven curved rays; body fleshy and whitish; large scales; two dorsal fins. Gmelin notices only five species. Shaw mentions nine. M. cephalus, or the common mullet, is generally about fourteen inches in length, and is found not only in the Northern and Mediterranean Seas, but in the Indian and Western Oceans. These fishes collect in vast multitudes almost close to the shores, in quest of those aquatic insects which constitute their food, thrusting their heads into the soft muddy bottoms with incessant activity. On the approach of summer they assemble in immense numbers, to ascend rivers, which they do to a considerable distance from the sea, in order to deposit their ova; and while they are thus assembled, the fishermen avail themselves of the transient opportunity, and, spreading their nets, take them in extraordinary abundance. They are regarded by many as excellent, but are not often seen at the tables of the opulent.

MUHLENBERGIA, in botany, a genus of the Triandria Digynia class and order. Natural order of Gramina, Garmineæ, or Grasses. Essential character; calyx one-valved, minute, lateral; corolla two-valved. There is but one species, *viz.* M. diffusa, which is a perennial grass, and a native of North America.

MULBERRY. See MORUS.

MULE, in zoology, a mongrel kind of quadruped, usually generated between an ass and a mare, and sometimes between a horse and a she-ass. The mule is a sort of a monster, of a middle nature between its parents, and therefore incapable of propagating its species: so careful is nature to avoid filling the world with monsters. Mules are chiefly used in countries where there are rocky and stony roads, as about the Alps, Pyrenees, &c. Great numbers of them are kept in these places; they are usually black, strong, well limbed and large, being mostly bred out of the fine Spanish mares; the mules are sometimes fifteen or sixteen hands high. No creatures are so proper for carrying large burdens, and none so sure footed. They are much stronger for draught than horses, and are often as thickset as our dray-horses; and they will travel several months together, with six or eight hundred weight upon their backs; they are much hardier and stronger than horses, and will live and work twice the age of a horse. Those mules which are light are fitter for riding than horses, as to the walk and trot; but they are apt to gallop very roughly. See EQUUS.

MULLER, or MULLAR, denotes a stone flat and even at the bottom, but round at top, used for grinding of matters on a marble. The apothecaries use mullers to prepare some of their testaceous powders, and painters for their colours, either dry or in oil. Muller is also an instrument used by the glass-grinders; being a piece of wood, to one end whereof is cemented the glass to be ground. It is ordinarily about six inches long, turned round.

MULLERA, in botany, so named in memory of Otho Frederick Muller, a genus of the Diadelphia Decandria class and order. Natural order of Papilionaceæ. Leguminosæ, Jussieu. Essential character: pericarpium elongated, fleshy, necklace form, with one-seeded globules. There is only one species, *viz.* M. moniliformis, a native of Surinam.

MULLET, or Mollet, in heraldry, a bearing in form of a flat, or rather of the rowel of a spur, which it originally represented. The mullet has but five points; when there are six it is called a star; though others make this difference, that the mullet is, or ought to be, always pierced, which a star is not.

MULLUS, the *surmullet*, in natural history, a genus of fishes of the order Thoracici. Generic character: head compressed and scaly; mouth bearded; gill membrane with three rays; body round, long and red, coated with large and easily deciduous scales. There are six species, according to Gmelin. Shaw reckons thirteen. The M. rubea, or red surmullet, is the fish which was one of the favourite delicacies of Roman epicurism, and which, when particularly scarce, might be sold for its weight in silver coin. Its colours are a rose red, olive, and silver, exquisitely blended; and, in a dying state, the surmullet exhibits those rapid and contrasted changes, which have often been described as particularly attending the expiring dolphin. From this circumstance this fish was considered among the Romans, as exhibiting a feast to the eye as well as the palate. Before it was delivered over to the cook, it was displayed in a transparent vase to the company assembled, and considered as affording a most interesting spectacle, by those rapid changes of colour which accompanied its expiring struggles, sometimes glowing with intense ardour, then fading into deathful pallidness. It is found in the Mediterranean and in the North Seas, and is about fourteen inches long.

MULTANGULAR, a figure, or body, which has many angles.

MULTILATERAL, in geometry, is applied to those figures which have more than four sides or angles, more usually called polygons.

MULTINOMIAL, or *multinomial roots*, in mathematics, such roots as are composed of many names, parts, or members; as $a+b+d+c$, &c. See Root.

MULTIPLE, in arithmetic, a number which comprehends some other several times; thus 6 is a multiple of 2, and 12 is a multiple of 6, 4, and 3, comprehending the first twice, the second thrice. &c.

Multiple *ratio*, or *proportion*, is that which is between multiples. If the lesser term of the ratio be an aliquot part of the greater, the ratio of the greater to the less is called multiple: and that of the less to the greater submultiple. A submultiple number is that contained in the multiple: thus, the numbers 1, 2, and 3, are submultiples of 9. Duple, triple, &c. ratios, as also subduples, subtriples, &c. are so many species of multiple and submultiple ratios.

MULTIPLICAND, in arithmetic, one of the factors in the rule of multiplication; being that number which is given to be multiplied by another, which is called the multiplicator, or multiplier.

MULTIPLICATION, in general, the act of increasing the number of any thing. See Arithmetic and Algebra.

Multiplication, *cross*, otherwise called duodecimal arithmetic, is an expeditious method of multiplying things of several species, or denominations, by others likewise of different species, &c. *e. g.* shillings and pence, by shillings and pence; feet and inches, by feet and inches.

This is much used in measuring, &c. and the method is thus:

Suppose 5 feet 3 inches to be multiplied by 2 feet 4 inches; say 2 times 5 feet is 10 feet, and 2 times 3 is 6 inches: again, say 4 times 5 is twenty inches, or 1 foot 8 inches; and 4 times 3 is 12 parts, or 1 inch: the whole sum makes 12 feet 3 inches. In the same manner you may manage shillings and pence, &c.

Ft.	*In.*
5	3
2	4
10	6
1	8
	1
12	3

MULTIPLYING *glass*, in optics, one wherein objects appear increased in number. It is otherwise called a polyhedron, being ground into several planes, that make angles with each other; through which the rays of light issuing from the same point undergo different refractions, so as to enter the eye from every surface in a different direction.

MULTISILIQUÆ, in botany, the name of the twenty-sixth order in Linnæus's "Fragments of a natural method;" consisting of plants which have more seed vessels than one. Of this kind are aconitum, monk's hood; delphinum, larkspur; nigella, or devil-in-a-bush; and many others. These plants are mostly perennial herbs: the stems of some are erect, others creep on the ground, and produce roots near the origin of each leaf, as in some species of ranunculus; others climb, and attach themselves to the bodies in their neighbourhood, either by the footstalk of their leaves, as the virgin's bower, or by tendrils which terminate the footstalk, as atragene. The flowers are hermaphrodite, and are easily rendered double by culture. The calyx is wanting in some; in the others it is generally composed of five pieces, which fall with the petals; but the calyx of the rue and peony is permanent. The petals vary; five is the prevailing number, but they differ from four to fifteen. The stamina are from five to three hundred, distinct, and attached, generally in rows, to the receptacle. The seed-buds are usually numerous, and so also are the seeds. Most of these plants are acrid, many of them are poisonous. The leaves of all the species of clematis being bruised, and applied to the skin, burn it into carbuncles; and if applied to the nostrils in a sultry day, immediately after being plucked, will cause the same uneasy sensation as a flame applied to that part would occasion.

MULTIVALVES, in natural history, the name of a general class of shell-fish, distinguished from the Univalves, which consist of only one shell, and the Bivalves, which consist of two, by their consisting of three or more shells. See CONCHOLOGY.

MUM, a kind of malt-liquor, much drank in Germany; and chiefly brought from Brunswick, which is the place of most note for making it.

MUMMY, a body embalmed, or dried, in the manner used by the ancient Egyptians: or the composition with which it is embalmed. There are two kinds of bodies denominated mummies: the first are only carcases dried by the heat of the sun, and by that means kept from putrefaction: these are frequently found in the sands of Lybia. Some imagine, that these are the bodies of deceased people, buried there on purpose to keep them entire without embalming; others think they are the carcases of travellers, who have been overwhelmed by the clouds of sand raised by the hurricanes frequent in those deserts. The second kind of mummies are bodies taken out of the catacombs, near Cairo, in which the Egyptians deposited their dead, after embalming. For a further account of mummies, and the manner of embalming dead bodies, see EMBALMING

We have two different substances preserved for medicinal use under the name of mummy, though both in some degree of the same origin: the one is the dried and preserved flesh of human bodies, embalmed with myrrh and spices; the other is the liquor running from such mummies, when newly prepared, or when affected by great heat or damps. This latter is sometimes in a liquid, sometimes of a solid form, as it is preserved in vials well stopped, or suffered to dry and harden in the air. The first kind of mummy is brought to us in large pieces, of a lax and friable texture, light and spongy, of a blackish brown colour, and often damp and clammy on the surface: it is of a strong but disagreeable smell. The second kind of mummy, in its liquid state, is a thick opaque and viscous fluid, of a blackish colour, but not disagreeable smell. In its indurated state, it is a dry solid substance, of a fine shining black colour, and close texture, easily broken, and of a good smell; very inflammable, and yielding a scent of myrrh and aromatic ingredients while burning. This, if we cannot be content without medicines from our own bodies, ought to be the mummy used in the shops; but it is very scarce and dear, while the other is so cheap, that it will always be most in use.

All these kinds of mummy are brought from Egypt, but we are not to imagine that any body breaks up the real Egyptian mummies, to sell them in pieces to the druggists, as they may make a much better market of them in Europe whole, when they can contrive to get them. What our druggists are supplied with is the flesh of executed criminals, or of any other bodies the Jews can get, who fill them with the common bitumen, so plentiful in that part of the world; and adding a little aloes, and two or three other cheap ingredients, send them to be baked in an oven, till the juices are exhaled, and the embalming matter has penetrated so thoroughly that the flesh will keep, and bear transporting into Europe. Mummy has been esteemed resolvent and balsamic; but whatever virtues have been attributed to it seem to be such, as depend more upon the ingredients used in preparing the flesh, than in the flesh itself; and it would be surely better to give those ingredients without so shocking an addition.

Besides the mummy, the human body has been made to furnish many other substances for medicinal purposes. Thus, the skull has been celebrated for its imaginary virtues against the diseases of the head; the very moss growing on the skulls of human skeletons has been supposed to possess anti-epileptic virtues; the fat of the human body has been recommended as good in rheumatisms; and the blood, and, in short, every other part or humour of the body, have, at one time or other, been in repute for the cure of some disease; but at present we are grown wise enough to know, that the virtues ascribed to the parts of the human body are either imaginary, or such as may be found in other animal substances. The mummy and skull alone, of all these horrid medicines, retain their places in the shops; and it were to be wished that they too were rejected.

MUNCHHAUSIA, in botany, so named from Baron Gerlach Adolphus de Munchhausen, a genus of the Polyadelphia Polyandria class and order. Natural order of Calycanthemæ. Salicariæ, Jussieu. Essential character: calyx six-cleft, torulose; petals clawed; stamens in six bodies, four or five in each; pistil superior, with a filiform curved style. There is but one species, *viz.* M. speciosa, a native of Java and China.

MUNICIPAL, in the Roman civil law, an epithet which signifies invested with the rights and privileges of Roman cities. Thus the municipal cities were those whose inhabitants were capable of enjoying civil offices in the city of Rome; these cities, however, according to Mariana, had fewer privileges than the colonies: they had no suffrages or votes at Rome: but were left to be governed by their own laws and magistrates. Some few municipal cities, however, obtained the liberty of votes. Municipal, among us, is applied to the laws that obtain in any particular city or province. And those are called municipal officers, who are elected to defend the interest of cities, to maintain their rights and privileges, and to preserve order and harmony among the citizens. Such as mayors, sheriffs, consuls, &c.

MUNTINGIA, in botany, so called from Abraham Munting, professor of botany at Groeningen, a genus of the Polyandria Monogynia class and order. Natural order of Columniferæ. Tiliaceæ, Jussieu. Essential character; calyx five-parted; corolla five-petalled; berry five-celled; seeds many, nestling. There is but one species; *viz.* M. calabura, villose Muntingia, a native of Jamaica, on the calcareous subalpine hills; and of St. Domingo, in the moist parts of woods.

MURÆNA, the *eel*, in natural history, a genus of fishes of the order Apodes. Generic character: head smooth; nostrils tubular; gill-membrane ten-rayed; eyes covered by the common skin; body round, smooth; and mucous spiracle behind the head or pectoral fins. There are fives species, according to Shaw. Gmelin enumerates nine, of which the following are most deserving of notice. M. anguilla, or the common eel. This species is particularly distinguished by the steadiness or uniformity of its colours; an olive brown on the back, and silvery lustre on the sides and beneath; but more expressively still by the great elongation of its under jaw. Its general size is from two to three feet; it is slow in its growth, and considered as very long lived. Its usual food consists of insects, worms, and the eggs of other fishes. It is viviparous, producing great numbers at a birth; but of a very diminutive size. It continues generally during the day in its hole in the banks, which it furnishes with two avenues, to facilitate its escape and security. By night it ranges for food. In winter it appears to be ingulphed in mud, and remains in this state of seclusion and tranquillity, if not torpor, till the return of spring invites it to a renewal of its excursions. In some places the fishery of eels is carried to very great extent, and in one of the rivers of France 600,000 are said to have been taken by the net in the course of a single day. They are wholesome food when taken in moderation. They are to be met with in almost all rivers, lakes, and stagnant waters of Europe, abounding also frequently in marshes. Their tenaciousness of vitality is so great that they may be preserved in a cool situation, without water, for hours and even days. It is stated, by Linnæus, to quit the water frequently by night, and range the meadows in search of snails and worms; and, according to some writers, has been known to shelter itself in very severe weather in a hay rick; these circumstances, however, though not more extraordinary than many which are ascertained in natural history, appear to require further evidence. M. conger, or the conger eel, is generally darker above and more splendid beneath than the former species. It grows to its largest size in the Mediterranean, where it is sometimes found ten feet long, and of the weight of an hundred pounds. It is found in the North and American seas also: it occasionally, particularly in the spring, makes excursions into rivers, and is found in vast abundance in the Severn, constituting a cheap and luxurious food to the inhabitants in its vicinity. Congers are extremely voracious, devouring immense quantities of the smaller fishes, and of crabs, before the shell of the latter is completely formed and hardened. They are in some places no trifling article of commerce, and in Cornwall particularly, are taken with lines, having sixty or seventy hooks attached to each, baited with their favourite food. These lines are drawn to the land in the morning, having been sunk the preceding night, and generally exhibit a great number of victims. They are killed as fast as they are drawn to land, and if they wind about the legs of the man employed their compressive power is highly dangerous. They are then salted and dried, during which latter process two-thirds, or more, of the weight of the fish will not unfrequently drain off in oil. They are exported in large quantities to the coasts of Spain and Portugal. For the Muræna catenatus, chain-striped Muræna, see Pisces, Plate V. fig. 5.

MUREX, in natural history, a genus of insects of the Vermes Testacea class and order. Animal a Limax; shell univalve, spiral, rough, with membranaceous sutures; aperture oval, ending in an entire straight or slightly ascending canal. There are between two and three hundred species, separated into sections. A. Spinous, with a produced beak. B. Sutures, expanding into crisped foliations; beak abbreviated. C. With thick protuberant rounded sutures. D. More or less spinous, and without manifest beak. E. With a long, straight, subulate closed beak, and unarmed with spines. F. Tapering; subulate, with a very short beak. M. Caniculatus, is about six inches in length: inhabits the deep sea and bays. Dredged up in plenty with oysters. Eaten by the poor; and often used as a bait for other fish.

MURIATES, in chemistry, a genus of salts formed from the muriatic acid with certain bases. When heated they melt, and are volatilized, without undergoing decomposition: they are soluble in water; effervesce with sulphuric acid, and white acrid fumes of muriatic acid are disengaged; when mixed with nitric acid they exhale the odour of oxy-muriatic acid. There are twelve alkaline and earthy muriates. Muriate of potash, formerly called febrifuge, or digestive salt of sylvius, may be obtained by dissolving potash in muriatic acid, and evaporating the solution till the salt crystallizes: it has a disagreeable taste, and will dissolve in about three parts of cold water. Specific gravity 1.8. The constituent parts are nearly as follow:

Muriatic acid	29
Potash	63
Water	8
	100

Muriate of soda, or common salt, has been known from the earliest ages. It exists abundantly in nature. Immense quantities of it are found in different countries, which require only to be dug out and reduced to powder. In this state it is called rock salt. It is also one of the constituents of sea-water, which, when evaporated, yields the salt in crystals. This salt usually crystallizes in cubes: its specific gravity is about 2.12, and it is soluble in less than three times its weight of water. When pure, it is not affected by exposure to the air; but the salt of commerce contains some muriate of magnesia, which renders it deliquescent. When heated, it decreptiates, and in a red heat it melts and evaporates in a white smoke, without decomposition. It is composed of

Muriatic acid	44
Soda	50
Water	6
	100

See Salt.

Muriate of ammonia, formerly denominated sal-ammoniac, because it was found in great quantities near the temple of Jupiter Ammon, in Africa. It was till lately imported entirely from Egypt, but it is now made both in this country and on the continent. In its common form it is an opaque mass, and is not affected by the air, but its crystals are liable to deliquesce. It is decomposed by the sulphuric and nitric acids, which combine with alkali; and likewise by potash, soda, barytes, and lime, which unite with the acid. By the latter of these decompositions ammonia is obtained in a state of purity: hence, by breaking into small pieces muriate of ammonia, with soda, or potash, &c. and putting them together in a phial with a glass stopple, we get a good smelling-bottle. This salt is used in many of the arts. In soldering, it cleans the surface of the metals to be united, and prevents their oxydation: in dyeing, it renders several colours brighter, and it is not unfrequently employed in pharmacy and chemistry: it consists of

Muriatic acid . . .	58
Ammonia	14.9
Water	37.1
	100

MURIATIC *acid*, in chemistry, may be procured in various ways: if a retort with a curved tube be half filled with well dried common salt, and some strong sulphuric acid be poured upon it, a copious effervescence takes place, and the elastic fluid extricated appears in the form of a white vapour as soon as it comes in contact with the atmosphere. When all the common air has been driven out of the retort, the subsequent portions of gas may be collected in the usual manner in glass jars, filled with mercury, and inverted in a bath of the same fluid. This is muriatic acid gas: it is transparent, colourless, and possessed of the same mechanical properties as common air. It is almost twice as heavy as common air: 100 cubic inches of it weighs nearly 60 grains. Its smell is pungent, and its taste highly acid. It is instantaneously fatal to animal life, and is incapable of supporting combustion: but if a burning taper be plunged into it, the flame, just before it goes out, may be observed to assume a green colour. If a little water be let into a jar filled with this gas, the whole gas disappears, and the liquid, which consists of a solution of muriatic gas in water, is usually denominated simply muriatic acid. Being obtained from salt, it was originally called "spirit of salt," then "marine acid," and now it is almost universally denominated "muriatic acid." A cubical inch of water, at the temperature of 60°, absorbs 515 inches of muriatic acid gas, which are equivalent to 308 grains: hence water thus impregnated contains more than half its weight of muriatic acid, in the same state of purity as when gaseous. During the absorption of the gas, the water becomes hot. Ice also absorbs this gas, and is at the same time liquified. The quantity of this gas absorbed by water diminishes as the heat of the water increases, and at a boiling heat water will not absorb any of it: of course the gas is easily expelled from the liquid acid by heat, and may readily be procured by heating the common muriatic acid of commerce. By this process Dr. Priestley first obtained it. The muriatic acid of the shops is always yellow, owing to a small quantity of iron which it holds in solution.

Muriatic acid is capable of combining with oxygen, and forms with it compounds, which have a considerable analogy to the compounds of azote with the same principle. When this acid is poured upon black oxide of manganese, a gas comes over, that is sometimes called "dephlogisticated muriatic acid," but more generally "oxy-muriatic acid." It is green, has a very bad odour, and is readily absorbed by water. The constituent parts of oxy-muriatic acid are,

Muriatic acid . . .	89
Oxygen	11
	100

When a current of oxy-muriatic acid is passed through water holding potash in solution, a number of flat shining crystals are deposited: these are denominated hyper-oxy-muriate of potash. They contain

Muriatic acid . . .	34
Oxygen	66
	100

It does not appear that either hydrogen or carbon combines with muriatic acid, but charcoal absorbs it abundantly. Phosphorus absorbs a little, and sulphur imbibes it slowly. When mixed with nitric acid, it forms what was formerly denominated "aqua regia," but is now called "nitro-muriatic acid." Muriatic acid in a state of gas neutralizes putrid miasmata, and destroys their bad effects. By this the most contagious diseases are prevented from spreading: two parts of sulphuric acid, and six of common salt, heated over a spirit lamp, or in a hot sand bath, will give out the gas very plentifully. The use of muriatic acid in the laboratory is very considerable; but in medicine and the arts it is employed only in the form of a muriate, or combined with some salifiable base. Nothing, says Mr. Aikin, takes off the crust of oxide of iron, which is sometimes found adhering to glass vessels, so safely and quickly, as a little warm dilute muriatic acid.

MURRAYA, in botany, so named in honour of Joseph Andrew Murray, professor of medicine and botany at Gottingen, a genus of the Decandria Monogynia class and order. Natural order of Aurantia, Jussieu. Essential character: calyx five-parted; corolla bell-shaped, with a nectary encircling the germ: berry one-seeded. There is but one species; *viz.* M. exotica, ash-leaved Murraya, a native of the East Indies.

MUS, the *rat*, in natural history, a genus of Mammalia of the order Glires. Generic character: fore-teeth, upper, wedge-formed: three grinders almost always each side each jaw; clavicles in the skeletons. There are forty-six species, of which we shall notice the following:

M. zibethicus, or the musk rat, is as large as a small rabbit, and very common in Canada; and resembles the beaver in the shape of its body, and in its instincts and character. It lives in society, and constructs its habitation with great skill and art, about two feet in diameter, and stuccoed within with particular neatness, on the border of some lake or stream. On the outside it is covered with a matting of rushes, compacted with great closeness, to preclude moisture. These animals live on roots and herbage, which, however, they do not store up in their houses, but make excursions for, as they are demanded during the winter; in summer, they make long progresses in pairs. They have attached to them a strong odour of musk; and walk and run with great awkwardness; are easily tamed, and highly valued for their fur.

M. decumanus, or the Norway rat, is imagined to have been imported into Europe from India, and in this country has almost extirpated the animals known by the name of black rats, which formerly universally abounded in it. It subsists not only on grain and fruits, but frequently attacks poultry and rabbits, as well as various other animals. It is about nine inches long in the body, and nine more in the tail; will swim with considerable ease; is in the highest degree prolific, producing occasionally even eighteen young at a time, and breeding not unfrequently three times a year. It is bold, fierce, and voracious. When closely followed, it turns on its enemy, and fastens on him with its sharp and irregular teeth, inflicting a wound which it requires considerable time to heal. The depredations committed by these animals are calculated at an almost incredible amount. Their extreme fecundity, and their means of eluding the hostility of man in a thousand instances, render them one of the most serious nuisances. They plunder pigeon-houses, granaries, warehouses, and every species of stores convertible to food, with incessant rapacity and perseverance. They carry off sometimes considerable quantities of grain, and store it in their holes. They wage, however, most dreadful war on one another, and the weak become uniformly the victims of the strong. The large male rat, which generally lives in a mischievous and malignant solitude, is the most fatal enemy to his species. Dogs, cats, and weasels, combine their efforts with those of man to produce their extirpation; but nothing appears capable of counteracting their rapid multiplication, and producing security from one of the most predatory and annoying animals which infests the society of mankind. Their sagacity is very extraordinary; and snares laid for them, after one victim has been known to fall by them, are generally laid in vain. The surest method of destroying them is by mixing poison with some favourite food, and laying it in their way. See Mammalia, Plate IX. fig. 4.

M. rattus, or the black rat, is considerably smaller than the former, and in the populated part of this country has been nearly annihilated by it. Its habits are almost precisely similar to those of the former. It is reported by travellers, that in various parts of Germany it is sometimes taken and domesticated, and having a bell put round its neck, is thus almost invariably found to alarm all others of it species from the vicinity.

M. amphibius, or the water rat, inhabits both the temperate and cold climates of Europe and Asia, frequenting the banks of rivers, in which it burrows. It subsists on frogs, and roots and other vegetable substances; swims with great speed, and can remain under water a considerable time. It is more thick and short in its body than several other species. It is never known to infest houses.

M. lemmus, or the leming. These animals are sometimes five inches long in the body, and in some countries (as Siberia) only three. They abound in the mountainous districts of Norway and Lapland. In their general habits they are by no means particularly social; but reside in a dispersed manner, without skilfully contrived habitations, or storing up in magazines. On certain occasions, however, they descend from their elevated situations into the plains, in innumerable and formidable multitudes. Their direction is always in a straight line, from which nothing induces them to deviate but the absolute impossibility of proceeding in it. Their track is visible by the destruction of herbage which attends it, the grass being devoured to its extreme roots, and their course exhibiting, instead of the greenness of vegetation the brownness of a fallow. These migrations happen at irregular periods, generally after an interval of some years, and the perseverance and intrepidity with which they are conducted are matter of astonishment. If attacked by men, they will spring at the legs of the assailants, and with great difficulty can be made to quit their hold. Thousands are destroyed in these progresses by birds of prey, and often the most formidable and fatal conflicts occur among themselves.

M. œconomus, or the œconomic rat, resembles the leming in the circumstance of irregular migrations. These are met with, particularly in Siberia, burrowing with the greatest skill, and forming considerable magazines of provisions (chiefly various plants) for their winter consumption, and which they occasionally produce, if damp, to dry them perfectly in the sun. They are about five inches and a quarter in their whole length. In their migrations they swim over rapid rivers, preserving a course directly to the west, and experiencing extreme fatigue and peril, to which immense numbers of them become victims. A single party has been seen so numerous, as to take two hours in passing before the astonished spectator. Scarcity of food is supposed the grand impulse of these progresses. The inhabitants of Kamtschatka are said to rob the hoards of these animals in winter, pretending to make compensation by leaving some childish toy behind.

M. cricetus, or the hamster, is a species of the pouched rats, and the sole European species of that description. The pouches are one on each side of the mouth, and, when filled, are like two blown bladders. These animals are found in Poland and Russia, and are extremely injurious by the quantities of grain which they devour, and also carry off for their autumnal store in their curious pouches. They are highly curious in the structure of their habitations. The females arrange their mansions differently from the males, and are stated never to reside with them. As winter approaches, they seclude themselves completely, and enjoy their stores, which are generally consumed when winter reigns in full rigour, about which time they roll themselves up, and continue till spring in a state of profound slumber, or torpor. Their bodies are then said to be perfectly cold, and their limbs stiffened, and they may be opened without awaking them. The heart is seen to beat in them fifteen times in a minute, while in the summer its pulsations are 150 in the same time. The fat is said to be coagulated, and the intestines exhibit no excitability by the most stimulating applications. The waking of the hamsters from their lengthened sleep is a very gradual process, occupying sometimes no less than two hours. These animals are unsocial, fierce, and malignant. They attack every weaker creature, and very frequently destroy each other.

M. musculus, or the common mouse, inhabits almost every part of the world, is shy and timid, but not ferocious in its temper. It produces generally from six to ten at a birth, and breeds several times in the course of a year. Its skin is sleek, and its eyes are bright and lively; its limbs are neatly formed, and its movements are extremely agile. It is occasionally seen of perfect whiteness, and its appearance then is beautiful and interesting. It haunts the habitations of man, from which it is scarcely ever found at any considerable distance, and in which it commits no trifling depredations.

M. sylvaticus, or the long-tailed field mouse, is somewhat larger than the former, and of a yellowish-brown colour. It feeds on acorns, fruits, and grain, and lays up magazines in its burrowed mansion for the winter. It is found principally in dry grounds; is common in all the temperate regions of Europe, and is particularly abundant and destructive in France, where it is stated to commit more waste and havock than are effected by all other quadrupeds, and birds also. Under a scarcity of the usual supplies, these animals are supposed to destroy each other. Their stores in fruitful years are astonishingly great, and nearly a bushel of nuts and mast is said to have been discovered in a single hole.

M. messorius, or the harvest mouse of Europe, is considered as the smallest of British quadrupeds, weighing only the sixth part of an ounce. Its nest is most artificially constructed, and platted of the blades of wheat, and is the size of a cricket ball, the opening to it being closed up so skilfully as to be almost imperceptible. Such is its compactness, that it may be rolled over the table without derangement. One found of this description, contained eight young, and appeared completely full without the dam, whose mode of access to it, so close and compact as it appeared on every side, seemed not easy to be explained. In the winter these animals burrow deep in the earth; but their favourite habitation is the corn stack.

For M. lineatus, or the lineated mouse, see Mammalia, Plate XVI. fig. 1.

For M. striatus, or the striated mouse, see Mammalia, Plate XVI. fig. 2.

MUSA, in botany, so named in memory of Antonius Musa, the freedman of Augustus, a genus of the Polygamia Monoecia class and order. Natural order of Scitamineæ. Musæ, Jussieu. Essential character: calyx spathe partial, many-flowered; corolla two-petalled; one petal erect, five-toothed, the other nectariferous, concave, shorter; stamens six; style one; all the flowers hermaphrodites: male, hermaphrodite above; five filaments perfect; germ inferior, abortive: female hermaphrodite, one filament only perfect; berry oblong, three-sided, inferior, many-seeded. There are three species, of which M. paradisiaca, plantain tree, rises with a soft herbaceous stalk, fifteen or twenty feet in height: the lower part of the stalk is frequently as large as a man's thigh, diminishing gradually to the top, where the leaves come out on every side, which are often more than six feet long, and two broad; they are thin and tender, so that where they are exposed to the open air they are generally torn by the wind: when the plant is grown to its full height, the spike of flowers will appear from the centre of the leaves, nearly four feet in length, nodding on one side; the upper part of the spike is made up of male or barren flowers; the fruit is about nine inches long, and more than an inch in diameter, a little incurved, having three angles; the skin is tough, within is a soft pulp, of a luscious sweet flavour; the spikes of fruit are often so large as to weigh upwards of forty pounds. It is a native of the East Indies, and other parts of the Asiatic continent; it is generally cultivated between the tropics, and is universal in all the islands, that are inhabited, of the southern Pacific Ocean. M. sapientum, banana tree, differs from the preceding in having its stalks marked with dark purple stripes and spots; the fruit is shorter and rounder, with a softer pulp of a more luscious taste; it has been noted for its efficacy in correcting those sharp humours, which generate or accompany the fluxes to which Europeans are frequently subject on their first coming into the West Indies. These two fruits are said to be among the greatest blessings bestowed by Providence upon the inhabitants of hot climates; three dozen plantains are sufficient to serve one man for a week instead of bread, and will support him much better.

MUSCA, in natural history, the *fly*, a genus of insects of the order Diptera: mouth with a soft exserted fleshy proboscis, and two equal lips; sucker furnished with bristles; feelers two, very short; antennæ generally short. This is a very numerous genus; not fewer than a thousand species have been enumerated. They are divided into sections; *viz.* A. with short feelers; and B. without feelers. These sections are again separated into others. The larva in the different tribes of flies differ far more in habit than the complete insects, some being terrestrial, and others aquatic. Those of the common kinds are emphatically distinguished by the title of maggots, and spring from eggs deposited on various putrid substances. Several of the aquatic kinds are of singularly curious formation, and exhibit wonderful examples of the provision ordered by nature for the preservation of even the meanest of animals. The general form of the pupa is that of an oval, differently modified, according to the species, and formed by the external skin of the larva. Some species cast their skin before their change into the pupa state. One of the most remarkable species is M. chamæleon, which is a large black fly, with a broad flattish abdomen, having the sides of each segment yellow, forming so many abrupt semi-bands across that part. It proceeds from an aquatic larva, of very considerable size, measuring two inches and a half in length, which is common in stagnant waters during the summer months, and passes into its chrysalis state without casting its skin, which dries over it, so as to preserve the former appearance of the animal in a more contracted state. M. tenax is a remarkable insect, about the size of a drone, of a brown colour, with transparent wings. It proceeds from a larva of a very singular appearance, being a long-tailed brown maggot, of rather a slow motion, measuring about three quarters of an inch in length. This maggot is seen in muddy stagnant waters, drains, and other places of the dirtiest description: and, notwithstanding its unpleasant appearance, exhibits many particulars well worthy of admiration: the feet are wonderfully calculated for enabling the animal to ascend walls, or other perpendicular places, in order to seek some proper situation, in which it may undergo its change into chrysalis, being very broad, and beset on their under surface with numerous small hooked claws, giving it the power of clinging with security during its ascent. The larva commonly changes to a pupa about the end of August, the skin contracting and drying round the body, and the tail continuing in a shrivelled state. After remaining in this state about a fortnight, it gives birth to the complete insect. It is common in England in the month of September, and is often mistaken for a drone. Among the bristly flies is the M. carnaria, or common blow-fly, which deposits its eggs on animal flesh, either fresh or putrid. The larva, or maggots, hatch in the space of a few hours, and when full grown, which happens in eight or ten days, they are of a yellowish colour, with a slight tinge of pale red. When the animal changes to a pupa, the skin dries round it, and the whole assumes a completely oval form, and a reddish colour. In ten days after the fly emerges.

MUSCI, in botany, *mosses*, one of the seven families into which Linnæus divided all vegetables. The characteristics of these plants are, anthers without filaments: the male flower constituted by the presence of the anthers, placed apart from the female, either on the same or distinct roots; the female flower deprived of the pistillum; the seeds devoid of both lobes, and proper coverings. These plants constitute the second order of the class Cryptogamia, which contains all the plants, in which the parts of the flower and fruit are wanting, or are not conspicuous. This order is subdivided into eleven genera, from the presence or absence of the calyx, which in these plants is a veil that is placed over the tops of the stamina, and denominated calyptra; from the sexes of the plants, which bear male and female flowers, sometimes on the same, sometimes on distinct roots, and from the manner of growth of the female flowers, which are sometimes produced singly, sometimes in bunches or cones.

Musci, is also the name of the fifty-sixth order in Linnæus's Fragments of a Natural Method, consisting of a genera, which are exactly those of the second order in the class Cryptogamia. These plants resemble the pines and firs, and other evergreens in that class, in the form and disposition of their leaves, and manner and growth of the female flowers, which are generally formed into a cone. They frequently creep and extend themselves like a carpet upon the ground, trees, and stones, collected into bunches or tufts. Few of the mosses are annual plants; they are mostly perennial and evergreens. Their growth is remarkably slow; though preserved dry several years, these plants have the singular property of resuming their original verdure upon being moistened. They delight in a cool moist situation, and northerly exposure, where they are screened from the sun. The roots are fibrous, slender, branched and short. The stems and branches are cylindric, and weak, they creep on the ground, and strike root on every side.

MUSCICAPA, the *fly-catcher*, in natural history, a genus of birds of the order Passeres. Generic character; bill flattened at the base, nearly triangular, notched each side, at the root beset with bristles: toes, in general, divided to their origin. These birds are of eminent utility in warm climates, by preying upon the numerous insects which swarm in them, and which would otherwise multiply to an extent, occasioning the most severe and intolerable annoyance. Latham enumerates seventy-eight species, Gmelin ninety-seven, of which it will be sufficient to notice the following:

M. grisola, or the spotted fly-catcher, arrives in England in the spring, and leaves it in September. It attaches its nest not unfrequently to the end of a beam of a house; and sometimes builds it in a vine or sweet briar tree, spread against a wall, and appears to feel no inconvenience or alarm from the circumstance of many persons passing to the door, almost immediately under it, at every hour in the day. It returns for a succession of seasons to the same situation. It feeds on insects, which it catches with astonishing dexterity, sometimes on the wing, sometimes by a sudden leap from its perch, always returning to its station with the object of its aim. It is one of the most silent and most familiar of summer birds. Its only note is a plaintive sound on the approach of danger. In Kent it is called the cherry-sucker, being particularly fond of that fruit.

M. atricapella, or the pied fly-catcher, is not to be found in great numbers in any part of Great Britain, but is most frequently to be met with in Yorkshire, and the contiguous counties. A nest belonging to two birds of this species was taken in 1803, in Axwell Park, with a great number of young, and also the parent birds. The assiduity of the latter, which were almost unremittedly employed in taking flies for their numerous family, was highly interesting. The dexterity and attention of the male bird appeared most conspicuous. See AVES, Plate X. fig. 3.

MUSCLE, in anatomy, a part of the human body, destined to move some other part, and that in general by a voluntary motion, or such as is dictated by the will; being composed principally of flesh and tendinous fibres, which have also vessels of all kinds, as arteries, veins, nerves, and lymphatics; all which are surrounded by, or enclosed in, one common membrane. See ANATOMY.

In a chemical view, the muscular parts of animals are known in common language by the name of flesh. They constitute a considerable proportion of the food of man. Muscular flesh is composed of a great number of fibres and threads, of a reddish or whitish colour; these, after they have been acted on by water, in order to separate the extraneous matter from them, are left in the state of grey fibres, insoluble in water, and becoming brittle when dry. The substance possesses all the properties of FIBRIN, which see. Besides fibrin, they are found to contain albumen, gelatine, extractive, phosphate of soda, of ammonia, and lime.

The muscles of different animals differ exceedingly from each other in their appearance and properties, at least as articles of food; but we know little of their chemical differences. The observations of Thouvenel alone were directed to that object, and they are imperfect. The flesh of the ox contains, according to him, the greatest quantity of insoluble matter, and leaves the greatest residuum when dried; the flesh of the calf is more aqueous and mucous; the land and water turtle yields more matter to water than the muscle of the ox; but Thouvenel ascribes the difference to foreign bodies, as ligaments, &c. mixed with the muscle of the turtle. Snails yield to water a quantity of matter intermediate between that given by beef and veal: with them the muscles of frogs, cray-fish, and vipers, agree nearly in this respect; but the muscles of fresh water fish, notwithstanding their softness, yield a considerably smaller proportion. When meat is boiled, it is obvious that the gelatine, the extractive, and a portion of the salts, will be separated, while the coagulated albumen and fibrin will remain in a solid state. Hence the flavour and the nourishing nature of soups derived from the extractive and gelatine. When meat is roasted, on the other hand, all these substances continue in it, and the taste and odour of the extractive is greatly heightened by the action of the fire. Hence the superior flavour of roasted meat. Fourcroy supposes, that the brown crust which forms on roasted meat is composed entirely of the extractive. The cutis is a thick dense membrane, composed of fibres interwoven like the texture of a hat. When it is macerated for some hours in water, and agitation and pressure are employed to accelerate the effect, the blood, and all the extraneous matter with which it was loaded, are separated from it, but its texture remains unaltered. On evaporating the water employed, a small quantity of gelatine may be obtained. No subsequent maceration in cold water has any further effect. When distilled, it yields the same products as fibrin. The concentrated alkalies dissolve it, converting it into oil and ammonia. Weak acids soften it, render it transparent, and at last dissolve it. Nitric acid converts it into oxalic acid and fat, while, at the same time, azotic gas and prussic acid are emitted. When heated it contracts, and then swells, exhales a fetid odour, and leaves a dense charcoal difficult to incinerate. By spontaneous decomposition in water or moist earth, it is converted into a fatty matter, and into ammonia, which compose a kind of soap. When allowed to remain long in water, it softens and petrifies, being converted into a sort of jelly. When long boiled in water it becomes gelatinous, and dissolves completely, constituting a viscid liquor, which, by proper evaporation, is converted into glue. Hence the cutis of animals is commonly employed in the manufacture of glue. From these facts the cutis appears to be a peculiar modification of gelatine, enabled to resist the action of water, partly by the compactness of its texture, and partly by the vicidity of the gelatine of which it is formed; for those skins which dissolve most readily in boiling water afford the worst glue. The skin of the eel is very flexible, and affords very readily a great proportion of gelatine. The skin of the shark also readily yields abundance of gelatine; and the same remark applies to the skins of the hare, rabbit, calf, and ox; the difficulty of obtaining the glue, and its goodness, always increasing with the toughness of the hide. The hide of the rhinoceros, which is exceedingly strong and tough, far surpasses the rest in the difficulty of solution and in the goodness of its glue. When skins are boiled, they gradually swell, and assume the appearance of horn; they then dissolve slowly.

MUSEUM, a collection of rare and interesting objects, selected from the whole circle of natural history and the arts, and deposited in apartments or buildings, either by the commendable generosity of rich individuals, general governments, or monarchs, for the inspection of the learned, and the great mass of the public.

The term, which means, literally, a study, or place of retirement, is said to have been applied originally to that part of the Royal Palace at Alexandria appropriated for the use of learned men, and the reception of the literary works then extant. According to ancient writers, they were formed into classes or colleges, each of which had a competent sum assigned for their support; and we are further informed, that the establishment was founded by Ptolemy Philadelphus, who added a most extensive library.

It would answer little purpose to trace the history of museums, as the earlier part of it is involved in much obscurity, and as we approach our own time, they multiply beyond a possibility of noticing even the most important. Within our brief limits we shall, therefore, confine ourselves to those at the Vatican, Florence, Paris, Oxford, and London. That of the Vatican might originally have been said to occupy every apartment of the palace, which are more numerous than in any other royal residence in the world; the pictures, the books, the manuscripts, statues, bas reliefs, and every other description of the labours of ancient artists, were select, uncommon, and valuable, in the extreme, particularly the Laocoon, which some authors assert is the same that adorned the palace of the Emperor Titus, and mentioned by Pliny, as *Opus omnibus et Picturæ, ei statuariæ, artis, præferendum*, who adds, that it was made by Agesander, Polydorus, and Athenodorus, natives of Rhodes, from a single mass of marble, which circumstance has since caused a doubt whether the groupe of the Vatican is really the original, as Michael Angelo discovered that it is composed of more than one piece. It was found in 1506, near the baths of Titus, and, whether an original or a copy, has obtained and deserves every possible admiration.

This invaluable collection continued to increase for several centuries, and till nearly the present period, when Rome narrowly escaped another sacking; but as a taste for the arts has fortunately distinguished the French, in some particular instances, it appeared in this, as a transfer of the richest articles to France has happily been preferred to destroying them.

The Grand Dukes of Tuscany were for a long series of years ardent admirers of the arts, ancient and modern, and regretted no expense in obtaining the most rare and beautiful objects, which vast treasures were capable of procuring; consequently their museum at Florence vied with that at Rome, and, in some instances, the value of particular articles exceeded any possibility of rivalship; we allude to the Venus de Medicis, of which Keysler speaks thus, in his excellent account of part of the continent: "I shall conclude this short criticism on the celebrated Venus de Medicis with the following observations, made by some able connoisseurs, namely, that if the different parts of this famous statue be examined separately, as the head, nose, &c. and compared with the like parts of others, it would not be impossible to find similar parts equal, if not superior, to those of the Venus de Medicis; but, if the delicacy of the shape, the attitude and symmetry of the whole be considered as one assemblage of beauties, it cannot be paralleled in the whole world. This beautiful statue is placed between two others of the same goddess, both which would be admired by spectators in any other place; but here all their beauties are eclipsed by those of the Venus de Medicis, to which they can be considered only as foils, to augment the lustre of that admired statue." The effects of the present dreadful, and apparently endless, war were severely felt at Florence; nor was it to be supposed that the museum of the Grand Duke would escape unmolested, when the contents of others, far less important, were conveyed to Paris: aware of the probable fate of the best articles, many of them are said to have been removed to places of safety. And particularly the beautiful Venus, and the Hercules Farnese, to Sicily. Little is known in England of the state of the Florentine museum, but it is feared to be deplorable.

We shall now turn our attention to the *Musee central des Arts*, formed in the Louvre at Paris, composed from the best collections on the Continent, and consequently consisting of the finest specimens of human art extant, which money could not procure, and supreme power alone could command from their previous situations, in the different circles of Germany, Holland, and the states of Italy. The only circumstance tending to alleviate the regret arising from this universal plunder is, the thought that every facility is afforded for viewing and studying the excellence of the various articles, which can be expected or desired. The method adopted for arranging the paintings thus assembled is judicious, as they are classed in nations, by which means the eye is conducted gradually to the acme of the art in the works of the Italian masters.

The gallery of antiquities is directly below the gallery of pictures; and to give some idea of the nature of the general contents, we shall mention the names of the several divisions, which are: La Salle de Saisons, la Salle des Hommes illustres, la Salle des Romains, la Salle de Laocoon, la Salle de l'Apollon, and la Salle des Muses. The laocoon, which we have noticed in our account of the Vatican, here receives distinguished honour within a space railed in · and the Apollo Belvidere is equally honoured in giving name to one of the halls. These exquisite works are described in a catalogue which may be obtained in the gallery; and of the manner we shall venture to give a specimen, hoping that a similar method may be adopted to explain the objects offered to view in our museums. Under the head Pythian Apollo, called the Apollo Belvidere, the author of the Catalogue observes, "This statue, the most sublime of those preserved by time, was found, near the close of the fifteenth century, twelve leagues from Rome, at Capo D'Anzo, on the borders of the sea, in the ruins of ancient Antium, a city equally celebrated for its Temple of Fortune, and for its pleasant mansions, erected by successive emperors, which, emulous of each other, they decorated with the most rare and excellent works of art. Julius II. when a cardinal, obtained this statue, and placed it in the palace where he resided, near the church of the Holy Apostles. After his elevation to the pontificate, he had it removed to the Belvidere of the Vatican, where it remained three centuries, an object of universal admiration. A hero, conducted by victory, drew it from the Vatican, and causing it to be conveyed to the banks of the Seine, has fixed it there for ever."

Another museum established at Paris, since the return of order, is that of the National Monuments; those were indiscriminately destroyed, or mutilated, during the first frantic emotions of the late revolution; and this act contributed not a little to the general dislike it excited: at length the most enlightened part of the National Convention decreed imprisonment in chains to those who should thenceforward injure or destroy the marble and bronze records of their country. Le Noir, a man of taste and learning, seized this opportunity for rescuing the French nation from the reproach it had incurred by destroying what was honourable to themselves; and conceived that, though late, it might still be possible to collect whole monuments in some instances, and fragments in others, sufficient to interest foreigners in favour of his country, or at least to evince to them that a change in sentiment had occurred. Fortunately, his plan received public encouragement, and he has, through the assistance of government, procured an astonishing number of specimens from all parts of the kingdom. Mr. Pinkerton observes of this collection, "It will not escape the attention of the reader of taste, that the arrangement is confused, nay, often capricious, and is capable of great improvements." And Le Maistre says upon the same subject, "After several hours employed in this second view, I continue of my former opinion, that the spot (formerly a convent) in which these monuments are collected, is infinitely too small; that the garden, meant to be the tranquil site of sepulchral honours, and the calm retreat of departed grandeur, is on so limited a scale, is so surrounded with adjoining houses, and altogether so ill arranged, that instead of presenting the model of

> 'Those deep solitudes……
> Where heav'nly pensive contemplation
> dwells,
> And ever musing melancholy reigns,'

it might easily be mistaken for the working yard of a statuary, or the pleasure ground of a tasteless citizen, decked out with Cupids, Mercuries, and Fawns." Both these authors, however, agree in praising the motives and perseverance of Le Noir.

Oxford has the honour of having produced the first, and not the least important museum in England, which was founded in 1679, and the building completed in 1683, at the expense of the university; the students, the public, and the professors of which, are indebted to Elias Ashmole, Esq. for an invaluable collection of interesting objects, presented by him for their use, and immediately placed within it; since which period it has been called the Ashmolean museum. The structure of the Corinthian order of architecture, has a magnificent portal: and the variety and value of the articles contained in it renders a visit to the apartments highly gratifying, particularly as they are increased from time to time, and as often as rare objects can be procured.

The British Museum, a repository under the immediate care of government, and itself governed by fifteen trustees, selected from the highest and most honourable offices of the state, promises to exceed every other national institution, which is not supported by the casual and unworthy plunder of others. However inferior it may appear to those splendid collections, which consist of the most exquisite productions of the chisel and the pencil ever accomplished by man, we have the consolation to reflect, that, had it been possible to procure them by purchase, the liberality of the British nation is such, that Italy and many other countries would have long since been drained; but as the case is, each inhabitant of England may exclaim, as he views the vast collection he in common with all his countrymen possesses, and with his characteristic integrity, these are individually our own by fair purchase or gift. Sir Robert Cotton may be said to have laid the foundation of the British Museum, by his presenting his excellent collection of manuscripts to the public; those, and the offer of Sir Hans Sloane's books, MSS., and curious articles in antiquity and natural history, for 20,000*l.* suggested the propriety of accepting the latter, and providing a place for the reception of both; from this time government proceeded rapidly in forming the plan, and at length every interior regulation for officers, trustees, &c. being made, Montague House, situated in Russell-street, Bloomsbury, was purchased for 10,250*l.* and fitted for the reception of the articles then possessed, and to be bought, at the further expense of 14,484*l.* 6*s.* 4*d.*; after which Lord Oxford's manuscripts were procured for 10,000*l.* to which the King added others; and since the above period vast numbers of interesting things have been placed there, particularly Sir William Hamilton's discoveries, a vast variety of valuable medals, fossils, minerals, manuscripts, and printed books, together with several Egyptian antiquities, and the late Mr. Townley's marbles and bas reliefs from Italy. The latter were given to the public, under the express condition that a proper place should be built for their reception, which has been complied with, and they are now exhibited with the rest of the museum to an admiring multitude, amounting daily to upwards of ninety persons. Various alterations have taken place in the regulations adopted for the convenience of those who read at the museum, and the visitors, since 1757, when it was first opened for inspection and study, and it is but justice to say, each was intended well, though till lately it was generally thought that too many impediments existed in the way of visiting that, which was solely intended for the use of the community; at present, however no such complaint can be made with truth, as any decently dressed persons, presenting themselves at certain hours, are conducted, free of every kind of expense, through the suit of rooms, by civil and well-informed officers, who explain the uses and nature of each object. Admission to the reading room is, besides, attended with no other difficulty than necessarily follows ascertaining whether the applicant is deserving of the indulgence, or likely to injure the interests of the institution; when there, every facility is afforded him by commodious tables, with pens and ink for writing, and a messenger waits to bring him any books he may think proper to select from the vast stores of literature submitted in this generous way to his use.

The Museums in the United States are none of them as yet very extensive, with the exception of Peale's Museum in Philadelphia. This valuable institution was founded in the year 1785, by Mr. Charles Wilson Peale; and by the industry and unremitted attention of this very meritorious individual, it has been raised to its present importance. The subjects of natural history are neatly prepared, and placed in their characteristic positions. Of these 212 are quadrupeds, upwards of twelve hundred birds, numerous fishes, reptiles, insects and shells, worms, zoophytes, and minerals—some anatomical preparations, and a skeleton of the mammoth, the great American mastodont. Besides the very interesting assemblage of objects of nature, there is a considerable collection of the costumes, implements of husbandry, warlike weapons, &c. of various uncivilized nations; also many monuments of antiquity, and mementos of departed nations, highly interesting to the antiquary—an extensive gallery of the portraits of distinguished men, the production of the pencil of Mr. Peale, consisting chiefly of warriors and statesmen of the American Revolution, and some of philosophers and men of science.

MUSES, certain fabulous divinities amongst the Pagans, supposed to preside over the arts and sciences: for this reason it is usual for the poets, at the beginning of a poem, to invoke these goddesses to their aid. Some reckon the muses to be no more than three, *viz.* Mneme, Aœde, and Melete; that is, memory, singing, and meditation: but the most ancient authors, and particularly Homer and Hesiod, reckon nine; *viz.* Clio, which means glory; Euterpe, pleasing; Thalia, flourishing; Melpomene, attracting; Terpsichore, rejoicing the heart; Erato, the amiable; Polyhymnia, a multitude of songs; Urania, the heavenly; and Calliope, sweetness of voice. To Clio, they attributed the invention of history; to Melpomene, tragedy; to Thalia, comedy; to Euterpe, the use of the flute; to Terpsichore, the harp; and to Erato the lyre and lute; to Calliope, heroic verse: to Urania, astrology; and to Polyhymnia, rhetoric.

MUSHROOM. See Agaric.

MUSIC. Any succession of sounds, however much they may vary in regard to duration, or however much they may partake of various modes or keys, provided that succession be agreeable, and excites, in a well tuned ear, certain agreeable sensations, is called music. Hence, it is obvious that all persons are not competent judges; for we often find individuals who have not only a natural defect in what we call the taste of music, but who cannot even sing three notes together without offending the ears of those who are happily blessed with that perfect formation of their organs, which disposes to the duly receiving, and of correctly expressing, the most undeviating pureness of melody.

Although we certainly may meliorate our taste, and indeed improve the ear, by constantly attending to correct sounds, and by making a rule never to allow the smallest trespass on the part of our voices, &c.; yet it may be generally said, that the passion, and the capability for music, must be innate. We could quote many instances of mere infants, even before they could speak, being perfectly competent to judge of what is commonly called "Music in or out of tune." All animals, however furious, appear delighted with music, which affects them differently, according to their several dispositions. Birds are even fascinated by the upper notes of a fine voice, and at all times we find such as have agreeable notes of their own, peculiarly attentive to every pleasing succession of sounds.

The most indispensable points in music are tune and time. The former relates to that perfect intonation of every sound which gives its proper degree of sharpness, or otherwise proportioned to its situation, and to its relation to those sounds which precede, or which follow. The latter is the art, or rather the talent, of bestowing the proper extent of each note's duration, according to the situation in which it is placed, and according to its relative value, as ascertained by that regular appreciation ascribed to it in the bar, according to established laws on which the time table is founded, as will be shewn in its proper place. It may be necessary, however, to state, that one exception is made from this, otherwise immutable, rule; namely, in vocal music, where the singer indulges in the prolongation of a note at pleasure; but such is only to be tolerated when a shake, a cadence, &c. allow the digression, without trespassing on the execution of the accompaniments, or violating that chaste adherence to the character of the piece, which should ever regulate the singer. This, however, is a point from which many of our first performers, both vocal and instrumental, deviate in a most unwarrantable manner;

often destroying the best effects of composition, by an indulgence in the most *outré* and inappropriate flourishes.

In speaking of tune we are necessarily to proceed by comparison; thus we call those shrill sounds which pierce the ear, acute or high; to this class appertain the natural tones of infantine voices, while the intonations of manhood vibrate with less shrillness upon the ear, and appertain to that class we term grave or low sounds. This will be more clearly understood when we state, that singers are divided into various classes, which accord with the supposed division of the voices of mankind into six different species, *viz.* the bass, which is the lowest of all; the basitono, or tenor-bass; the tenor and counter-tenor, which are the two middle species, of which the generality of men's voices partake; the mezzo soprano, which is the pitch of women's voices in general; and the soprano, *i. e.* the treble or uppermost, which in some women reaches to a great height, and in our cathedral service, &c. is usually allotted to young boys.

The voices of women and of children are, with very few exceptions (and those exceptions always appear unnatural, and are displeasing to the ear) a whole octave above the voices of men. The voices of girls do not suffer by puberty, at least not as to the acuteness of their sounds, though they often lose their clearness, and a portion of the extent upwards; but that arises from an injury done to the organs, often by overstraining while young, or by a want of practice, &c. whence the facility of inflexion, or of modulation, are essentially impaired. But with males the case is very different; for, so soon as they arrive at puberty a rapid change takes place, whereby the whole compass of the voice is sunk an octave, or eight notes. Thus a boy, who, at the age of ten or twelve, should be able to sing a piece of music in alt, that is, in high notes, when arrived at the age of sixteen or seventeen, in singing the same passages, would in reality be singing exactly an octave lower. The change is not regular as to any particular year; it varies greatly; some lose their voices even at twelve years old; these are, for the most part, of that class which never were above a counter-tenor, and sink into a basitono, or to a full bass. The few who are able to preserve their high pitch until seventeen, or perhaps eighteen years, rarely fall lower than the counter-tenor, and ordinarily become sopranos. These, however, are rare. In estimating voices, we are not to judge from the high notes occasionally produced, and which are the effect of much study and practice. The style is called the falsetto, and is an artificial voice, the junction of which to the natural intonation, so as to be perfectly smooth, is extremely difficult, and very rarely is found perfect, in even our best singers. Castration is supposed to produce this fictitious voice; but it is supposed that not one victim in a thousand of that description is rewarded by its attainment. Nature, indeed, seems to be very whimsical in this particular; for some castrati receive not the smallest benefit; they having, after all, deep-toned voices. This, it is true, does not often occur: the generality acquire, or rather perpetuate, a kind of mezzo, or middle intonation, more offensive than gratifying to the hearer.

The degrees of strength, the loudness or the softness of voices, have no effect whatever on the pitch or relative tone; for we may whisper in bass, and bawl in soprano. Therefore, when we say high or low, we either put the intonation to some audible test, as by reference to the sounds of instruments, &c. whose exact pitch is previously ascertained; or, in our minds, we form an estimation by aid of the memory, which refers to the graveness or acuteness, as it may happen, of some instrument, with whose notes the voice in question seems to correspond. Thus high and low are positive definitions, which force, or the accumulation of strength, as in choruses, will not render shriller or more acute, nor softness and whispering render more deep or graver. The terms are, however, only to be considered as arbitrary; for they have no real foundation in regard to the nature of sounds, and seem to depend entirely on the manner in which music is written, the shriller tones being placed the highest on the stave of five lines, and the deepest tones being represented by the lowest notes; thus forming a gradual decrease of acuteness from the highest to the lowest, which declension being, by this means, represented to the eye, enables us to judge, without hesitation, as to the pitch of the several intonations thus represented. By this means we are able to compare the pitch of two voices, or of any number of instruments whereby they might be accompanied; for by inspecting the music as written on the stave, and observing the relative ascendance of the notes, as allotted to, or as they could be executed by, each singer, we at once decide, that the person performing those notes, which reach the highest on the stave, sings higher than the other; therefore, if they should sing in parts, we should say the highest singer of the two took the first, and the lowest singer the second part of the music. The ancient Greeks used the terms high and low, in an opposite sense to what is above described. The lyres in use among them were so varied, that their gravest sounds were produced from the uppermost strings, and *vice versa*; hence they called the deepest notes high, and the acuter notes low.

It is not to be supposed that all the sounds which can, by any means, be produced, should be represented on the five lines, called the stave, although we never see more lines ruled for that purpose the whole length of the stave. There are many notes carried far above, and far below: their relative sounds are distinguished by what are called ledger (properly legere, or light) lines, the number of which serve to shew the degrees of altitude or of depression respectively. But it must be obvious how ineffectual even this substantial aid would be, to specify all the intonations contained in the six species already noticed. It is true, the upper, or soprano species, admits of much explanation, by the addition of perhaps four or five ledger lines above the stave; but the great number of sounds below the stave would require such a number of ledger lines under it, as would inevitably create confusion, and render it impossible for the most quick-sighted and most practised performer to follow the melody with precision. To remedy this inconvenience, and to do away many other practices, which, though improvements on the modes of the earlier ages, were not only very defective, but seemed to debar the progress of this pleasing science, the celebrated John de Murio, who lived in the fourteenth century, offered to the world a new system (from which very few alterations have since been made), whereby not only the value, *i. e.* the proper duration or holding of each note, was clearly defined by certain marks, but the compass, or extent of each voice, or part, was distinctly laid down by appropriate clefs, or keys, which are now vulgarly called cliffs. Until that time the pitch and value of every note were known only by letters and signs used for the occasion, according to Guido's notation.

This change was peculiarly important, and received additional approbation from its great simplicity; by it the whole orchestra were divided into three great classes, namely, the trebles, the tenors, and the basses; while, at the same time, the voice parts were more methodically arranged into five parts, consisting of two trebles (*i. e.* first and second), two tenors, and one bass, forming what we call a quintett; but in general only four were used, namely, the soprano, the counter-tenor, the tenor, and the bass; and, indeed, such seems, on the whole, to be the most natural division, for as we rarely find more than four notes used in any chord that is sounded at the same moment, so it appears proper that the number of parts, vocals at least, should be comprised within that arrangement; fewer would often cause the omission of many notes, whereon the harmony might essentially depend. The propriety of this will be more evident, when we come to treat of discords.

In speaking of parts, we are not to conclude that music is now confined to any particular number, although four, or five at the furthest, are as many as can be generally found useful, or even applicable to the purposes of our most conspicuous exhibitions, such as operas, oratorios, &c. Various eminent composers have arranged their pieces for even as many as fifteen or sixteen voices, each independent, and not merely the repetition or echo of others; these are called real parts, in contradistinction to such as are similar to others, but being performed on different instruments, or being an octave higher or lower, become mere reinforcements. Thus when we see an orchestra of forty or fifty performers, we are not to conclude that each performs a succession of notes different from his neighbours; on the contrary, all, who play the first violin parts, play exactly the same passages throughout; the seconds have also their part of the composition, which they play together; the tenors, first and second, sometimes in the same manner; the basses are also of various descriptions, such as the violincellos and the double basses. The wind instruments, such as the horns, trumpets, trombones, flutes, oboes, clarinets, the bassoons, and the serpents, are also classed, though each in general has its separate part, which, when sustaining any full passage, blends freely with the others of its own class, rarely deviating much therefrom, except in solo passages, wherein peculiar effects are to be produced. It may be supposed that most of these parts must be duplicates of others, either throughout, or partially, when we consider that the performer at the organ or harpsichord plays all the harmony, concentered, as it were, under his own hand. Knowing this, we must view the formation of numerous vocal parts merely as an exercise in the arts of permutation, as we see the youths of various parishes emulating in the ringing of various peals on the bells; or we must judge, that in instrumental music the various parts are necessary to produce a superior effect, derived from the judicious appropriation of various passages, or of various emphatic and accented notes, to those instruments most suited to the desired expression. We shall not be at a loss to estimate this branch of the science duly, when we call to mind, that by such a contrivance, which is by no means superficial, some composers have so completely expressed the passions of love, hatred, fear, grief, joy, &c. as to cause their audiences to become deeply affected, according to the intention and character of the music.

The relative gravity and acuteness of sounds were, as we have said, first arranged into a systematic point of view by John de Murio. He abolished the obscure and indefinite punctuations, &c. of his predecessors, and contrived the grand musical scale now in use, and which, notwithstanding the wonderful advances made in the science since his time, but especially within the last century, remains exactly as he first ushered it into the world. This we may presume to be the surest proof both of its excellence, and of his genius, for Murio was original in his invention, which does not appear to be, in any shape, built upon the devices of his seniors in the art. The following description, aided by reference to the plate, will, we trust, convey to the reader the fullest idea of the inventor's merit, and, at the same moment afford so complete an insight into the succession of sounds, and to the allotments of parts marked with different clefs, as must give the utmost satisfaction.

Fig. 1, Plate Music, exhibits the grand musical scale of John de Murio, consisting of eleven lines. The five uppermost are distinguished by a figure something like that which serves as an abbreviation for the word *and*—thus &. It was formerly meant for a written G, and is supposed to stand on the second line of the five included in the treble stave, *i. e.* the eighth of the whole stave, reckoning, as is the invariable rule in music, from the bottom upwards. This figure is called the G clef, and purports that the music standing on the stave appertains to the treble class of voices, or of instruments. The order, and the names of the notes appertaining thereto, are severally shewn, commencing with that G which stands under these ledger lines, and rising to D in alt, which will suffice to exemplify the extent of five octaves, and the manner in which the ledger lines are used to such notes as do not come within the compass of the stave.

The five lowest lines in the stave appertain to the bass clef, which is distinguished by an inverted C standing to the fourth line, on each side of which is a large dot, close to the back of the C. The presence of this sign denotes that the music appertains to that class of voices, or of instruments, whose deep tones rank them among the bass, or lowest species. The leger lines appropriate to the basses all stand below the first line of their stave, in contradistinction to the treble ledgers, which stand above: this is necessary to be well understood, because, whenever ledgers are added above the bass stave, the music, in reality, has changed its subordinate station, and has ascended into the class of tenors and sopranos, as will be seen. Nor can ledgers be added under the treble stave, without causing the music to partake of those tones which are also appropriate to the tenors. For the treble clef G, and the bass clef F, cannot be changed from the lines on which they are placed, and to which they respectively give name; the second of the treble being called the G line, and the fourth of the bass being called the F line.

The sixth, or middle line, which, for the sake of distinction, is made much thicker than the other ten, is called the C, or tenor line. Its characteristic sign is made by three perpendicular lines, extending to a depth corresponding with the thickness of the whole stave, *i. e.* of five lines, and terminated by a K; the two middle perpendiculars are joined by two short, thick, horizontal lines, equidistant from their centres. This sign is called the C, or tenor clef; it is moveable, but on whatever line its centre stands, the notes upon that line all become C, and the whole nomenclature of the notes on the stave changes in conformity thereto. The tenor clef governs the stave it is on, and occasions those who sing or perform its music to be called tenors; but of different degrees, according as the stave is found. This requires particular description: the tenor clef may remain on the C line, and taking two lines from the base, and two from the treble, complete its stave: in such case it is called the alto, and is always prefixed to every line of the music intended to be played on the tenor violin, or alto, or quinte, as it is variously designated. It also applies to such voices as answer that particular pitch. But as the greatest variety of voices lie between the treble and the bass parts, it was found necessary to move the tenor clef higher or lower, for the purpose of accommodating to those many and various compasses, which were found to be the greatest supports to the harmony, they connecting the extremes, *i. e.* of treble and bass, and sustaining the great body of the chorus, &c. To effect this, instead of confining the tenor stave to the C line, added to the two adjoining upper lines of the bass, and to the two lower of the treble, liberty was given to take, at pleasure, one, two, three, or even four lines from the treble, adding them above the C line: thus requiring only one, two, or three lines to be taken from the bass stave to complete the tenor stave to five lines. Hence we see, that instead of taking two lines from the bass, and two from the treble, as is done at A, fig. 1, to form the complement of its stave; at B it takes only one from the treble, and adds three from the bass to form a stave, which sinks the whole of the music a fifth, *i. e.* five notes. Again, at C, it borrows none from the bass, but takes four lines from the treble; this is called the soprano-tenor-clef, which depresses the music one-third, that is, three notes; it is usually applicable to such voices as are rather above the common pitch of the tenor and counter tenor, and of course rank as seconds, in choruses, glees, &c.

Composers frequently make use of the clefs, the tenor especially, for the purpose of transposing into other keys with the utmost facility: thus, if a piece of music be composed in the key of D, with two sharps, by annulling the sharps, and placing the tenor clef on that line where D stood, the whole piece is transposed one note lower. In the hurry of composition this is essentially useful, regarding such parts as are intended for horns, trumpets, &c. which never having sharps or flats prefixed to their staves, but being guided by a written notice as to what key the crooks should be arranged to (for their music is always written in C natural) by observing the clef, instead of any superscribed direction, and the proper crooks being affixed, according to the clef, the performers go through their parts without difficulty. The great importance of becoming perfectly familiar with this useful and versatile clef must be obvious; indeed the deficiency of a competent and ready knowledge of it, at sight, is not merely a disadvantage, but in many instances a complete disqualification; especially to public performers, who are often served with parts, either separately copied, or in a score, which they are expected to go through without hesitation or error.

Etymologists differ in regard to the derivation of the terms treble, tenor, bass, used for the names of the cleffs. Some derive treble from the theatre, others from the old practice of singing trios, in which the middle part, thence said to be called the tenor, bore the burthen; while the upper voice proceeded always a third, *i. e.* a treble above it. In all probability the latter is the most correct, though at the best we can only venture a conjecture, the strict derivation having been lost. The origin of the term tenor may, as some authors assert, be from the verb *teneo*, to hold; but the manner of its application, though from the same root, may be somewhat different; some have hinted, and not without reason, that it was on account of the tenor being that link which held the upper and lower parts together. As for the bass, that evidently proceeds from *bas*, *i. e.* low.

Having premised thus much, regarding those points which we deemed of much importance to have fully explained, before we proceed to detail the relations of notes, in regard to their places and to their distances on the stave, or scales, we will now treat of the latter, and also of the mode of ascertaining the key in which the music is composed. Respecting the value or duration of the notes, we shall reserve what is necessary to be stated, until we come to explain that most important matter, the time table.

There are but seven sounds in music, which are distinguished by the letters A, B, C, D, E, F, and G. The situation of the original sounds, of which all bearing those names are replicates, whether they be above or below those seven which we assume in any part of the stave as a standard, it is perhaps out of our power to ascertain, for every atom in nature is capable of producing some sound corresponding with some part of our scale, either perfectly in unison, or inclining to be sharper or flatter. Whatever may be the sound produced, we can, by the various means in common use, accommodate our instruments thereto. Thus, if any tone is heard, we can to a certainty accord, without deviating more than four notes either above or below the then pitch of the instrument that it is to imitate. For supposing a string to be tuned to A, and that a sound corresponding with the note E, below it, were heard, the intonation would be perfectly imitated, by relaxing the string until it should have descended six semitones, or a fourth; it would then correspond so very exactly, as to be in perfect unison with the sound in question; but if, instead of relaxing, the string were to be tightened, so as to cause its note to be raised eight semi-tones, or a fifth, the two sounds would blend completely, not in perfect unison, but in replicate unison; for the former term, in its strict sense, relates to sounds which positively yield the very same note in the same part of the scale.

This requires no proof to persons skilled in acoustics, or the science of sounds; but its demonstration would occupy more space than can be allotted to this article; under the head of SOUNDS more will be said. At present it suffices to state, that all notes of the same name are considered by harmonists as being the same note, as will be shewn; though the effects produced by placing them differently, in various parts of chords, are extremely various. The melodist, who is utterly unacquainted with music, as a science, and who whistles, or sings, either a well known air, or the wild effusions of his own imagination, naturally concludes, that every sound he can produce, from the lowest to the highest pitch of his compass, is a distinct note; not considering, that a woman or a child, who should sing the same tune with him, in what is called unison, (*i. e.* in the same sound), would absolutely sing throughout, in a parallel of notes, one octave above him! or that if accompanied by a base voice, that accompaniment would be a whole octave below him!

The truth of this is, however, firmly established, except in the minds of those few, who endeavour by sophistry, and a subtle mode of arguing, which, however, cannot bear the scrutiny of reason, to create a difficulty, by asserting that the note A, (&c.) between the second and third lines of the stave, cannot be the note A, which is intersected by the first ledger line above the stave! But if, when these two notes are sounded together, they so perfectly blend, that every auditor, however exquisite his sense of hearing, should not be able to discover more than one sound; and, that any vessel, such as a rummer, &c. should equally accord to either note, how can we say that the octave is a distinct note. We admit it to be a distinct degree in the scale of sounds, but maintain, that they are, at least, as closely allied as the echo is to the voice! But, let us suppose that a house were built so completely like a model, that, when the former were diminished, by means of a suitable mirror, it should be so very perfectly similar, as not to be distinguished from the model; or, that the latter should be magnified so as apparently to equal the house itself in bulk; and that, in such states, they could not be distinguished; what would the fastidious critic, or rather sceptic, say? "that they were not the same!" True,—nobody would doubt it; but they would be so forcibly represented to the sense, that, if shewn alternately, without the deception being known, the spectator would be mentally convinced that only one existed! We cannot, however, have a more satisfactory illustration of our position, than by adducing the well known fact, that all the instruments, of whatever pitch, used in a concert, and whether sounded by percussion, inflation, or collision, may be tuned from a common tuning fork, or by the given note of any instrument. We find also, that where a sharp, or a flat, is necessary in any part of the stave, the same is indispensable among all the parts, whether graver or acuter in their intonations.

Having established, we trust, in the most ample and substantial manner, that there are only seven sounds in music, we will now show the relation between them mutually, remarking, that, of course, every part of the scale must be affected in a similar manner as the octave we shall treat of, and which, for the sake of convenience, we shall select from the treble-stave, adding the tenor note C.

Example 2, represents what is called the extent of an octave; it is in the treble cleff, as may be seen by the prefixed figure. The lowest note is C, the scond is D, the third is E, the fourth is F, the fifth is G, the sixth is A, the seventh is B, and the eighth is C; forming a replicate of the first note C. Each of the above notes is designated according to the manner in which musicians compute them, always reckoning the first note 1, the next to it a second, and so on throughout: thus E is the third to C, and G is third to E, or fifth to C; always counting from, and including the lowest note. In the above example all the notes are what is termed natural, ♮; because no sharp, ♯, or flat, ♭, is necessary, to give them that relative distance which naturally prevails in the disposition of the eight preceding notes of an octave. This, however, only happens when C, ♯, is the first, and its octave the last note of the succession, and results purely from the above cause. This we shall explain. The notes do not all stand at equal distances mutually. The first interval, from C to D, is a whole tone, the second from D to E, is likewise a whole tone; from E to F, is only a simitone (or half a tone;) from F to G, is a whole tone; from G to A, is a whole tone; from A to B is a whole tone; and from B to C, is only a semi-tone.

The above are the distances at which nature has placed the notes composing an octave in the major key, of which, as well as the minor key, we shall treat amply.

If the notes, as thus arranged, be played on an instrument, or be sung by a well tuned voice, they will be found to follow in a most pleasing manner. The smaller intervals, as they are called, between the third E, and the fourth F; and between the seventh B, and the octave C; form the succession into two distinct periods, of which the former raises the expectation, while the latter satisfies it. We could not stop at F without disappointment; we should feel the want of some termination; whereas, at C, that termination is given; and we feel convinced that we have arrived at a conclusion.

Such is the case in every octave of which the key-note leads, and its eighth is the final; and so invariable is the succession of intervals we naturally expect to find in the major key, that every deviation therefrom distracts our attention, and sets the ear in search of that conclusion at which it never arrives. To prove this, let the lowest C, in the second example, be done away, and D be substituted above the upper C, as in Example 3: play all the notes natural, and the succession will not prove either pleasing or conclusive; because the order of the intervals is perverted. For, instead of the two first intervals being whole tones, the second (between E and F) is but a semitone; and in lieu of a whole tone between B, the sixth, and C, the seventh of the scale, there is but a semi-tone; and instead of a semi-tone between the seventh, C, and the eighth, D, there is a whole tone. Now, to remedy this, the third must be made to approach the fourth, and the seventh to approach the eighth: this is done by making them, *i. e.* F and C, both sharp; so that the distances between them and their next superior notes, should be reduced half a tone each; which halves of tones are thus added to the notes respectively below F and C; and the whole octave is duly regulated; the proper intervals being established: this is called "giving a sharp third and seventh:" whereby a major key is indicated. The minor key has two variable notes; namely, its sixth and its seventh. In ascending, they are invariably played sharp, the same as in the major key (or rather mode); but, in descending, they are played flat. Thus, in Example 4th, we take the key of C minor, which requires a flat third, a flat sixth, and a flat seventh. To effect this change, which gives a peculiar plaintive expression to the music, we are obliged to adjoin three flats (♭); namely, an E flat, to make the third so; an A flat, to depress the sixth; and a B flat, to reduce the seventh to a full semi-tone below the eighth. See example 4. The practical ear at once distinguishes the minor from the major mode: they may always be ascertained by counting the semi-tones included in the third: if the mode be major, there will be found five semi-tones; but if it be minor, only four. See Example 5th, where there are five, consequently the mode is major: in example 6th, which has three flats prefixed, there are only four; therefore the mode is minor. The following table of flats and sharps is of the utmost importance to be thoroughly understood.

TABLE OF MAJOR KEYS.

C has neither sharp nor flat prefixed.
D has F and C, sharp.
E natural, has F, C, G, and D, all sharp.
E flat, has B, E, and A, all flat.
F natural, has B flat.
F sharp, has F, C, G, D, A, and E, all sharp.
C natural, has F sharp.
A flat, has B, E, A, and D, all flat.
A natural, has F, C, and G, all sharp.
B flat, has B and E, flat.
B natural, has F, C, G, D, and A, all sharp.
C sharp, has every note sharp.

TABLE OF MINOR KEYS.

C has B, E, and A, all flat.
D has B flat.
E natural, has G sharp.
F natural has A, E, A, and D, all flat.
G natural, has B and E, flat.
A natural, has neither sharp nor flat.
B flat, has B, E, A, D, and G, flat.
B natural, has F and C, sharp.

Example 15, shows the flats or sharps necessary for bringing the notes into their proper intervals, as has already been shown, according to what note may be selected for the key. Thus we see in the first instance two sharps, F and C, with the note D, whence we know the key, or mode, to be major: after the first double bar, we see two flats, B and E, whence we know the key to be E flat major. The order in which the flats succeed in augmentation, is this: B, on the middle line of the stave, is always the first, because F is the first of the flat keys, and requires that B should be flat, to bring the notes to their proper intervals; for the next flat count a fourth upwards, and you have E flat, which added to B flat, gives the letter for the key; again, count another fifth upwards, and you have A flat, making three flats, with E flat for the key. The figures under the stave, at Example 16, show the order in which they thus follow and accumulate. The sharps proceed exactly the reverse, for they count downwards; thus F, being the first sharp, gives G for the key; for each succeeding sharp, counted by fourths down the scale, gives the note immediately above it for its key; therefore, counting the fourth downwards, we have C for the second sharp, and D for the key of two sharps: then, another fourth downwards, we find G, which being the third sharp, gives A for its key; and, descending still another fourth, we have D sharp, with E for its key. In this manner we see the succession of sharps marked in Example 17. Minor keys take the signs of the major keys, one third above them: thus B natural, minor, takes two sharps; which, by reference to the first table, will be seen to indicate the key of D major.

To elucidate what has been above said, respecting the ascent and descent of an octave in the minor key, the reader is referred to Example 7th: it is in the key of G minor, with two flats, B and E. It is to be remarked, that a sharp, prefixed on the line, or space, of any particular note, implies, that all notes of that name, wherever situated, whether octaves above, or below, are to be played sharp: a flat has the contrary effect, causing all to which it relates to be played flat. A natural is applied either way; when prefixed to a note that should else be played sharp, it causes it to be played half a note lower; *i. e.* natural: when before a note that should else be played flat, it raises it a semi-tone, causing it to be played natural. Those signs of sharp, or of flat, which are prefixed at the commencement of the stave, govern throughout the piece; while those sharps, flats, or naturals, which are found interspersed among the notes in the music, indicate that only the succeeding notes of that name, contained within that bar, are affected thereby; for those in the succeeding bars would be played according to the key of the piece, unless such accidental signs should be repeated in them. Besides, accidental signs may be contradicted in the same bar; of which the chrometic passage, in Example 8th, will be a sufficient explanation.

There are various kinds of notes, all different in their elevation; and there are various kinds of rests, each corresponding with some one kind of note, directs a pause or cessation of sound, during such time as the note corresponding with such rest would occupy in playing, according to the measure. Example 9, shows the form of each kind of note in modern use. No. 1, is a semibreve, which, in modern music, is held to be equal to a whole bar of common time. No. 2, is a minim, equal to half a semibreve. No. 3, is a crotchet, equal to a quarter of a semibreve. No. 4, is a quaver, equal to half a crotchet. No. 5, is a semiquaver, equal to the fourth of a crotchet. No. 6, is a demisemiquaver, equal to the eighth of a crotchet: the rests which correspond with these notes, are placed under them respectively. A bar may be made up of one semibreve, or of two minims, or of four crotchets, or of eight quavers, or of sixteen semiquavers, or of thirty-two demisemiquavers, or of any mixture of those notes, provided their aggregate does not exceed the value of four crotchets in a bar, for common time; or of three in a bar, for triple time. A dot, added after a note, causes it to be held half as long again as when not dotted; and when two dots are put, they lengthen the preceding note to three-fourths more than its original value; at 7, where a dotted minim and a crotchet make up the bar; at 8, a crotchet, a minim, and two quavers; at 9, a crotchet, four semiquavers, a dotted crotchet, and a quaver; at 10, only a semibreve. The commencement of Example 9th is marked with a C, through which is a perpendicular stroke: this sign, either plain, or so intersected, means common-time of four quavers (or their equivalents) in each bar: when we see $\frac{2}{4}$, it implies that there are only two crotchets, or four quavers, in each bar, as in Example 10th, in which every bar will be found to contain an equal measure of notes. When one or more notes are placed before the beginning of the first bar, such always are deducted from the last bar, and, with its amount, will be found to form a complete measure. At No. 5 and 6, in Example 9th, we see the notes in three several forms; the first are detached, the second four are tied, and the rest are all written in an abbreviated manner. The number of hooks, or strokes, affixed to the tail of a note, indicate its value: the more strokes, or ties, the shorter the note's duration: this will be seen also to affect the rest of all the shorter notes, in the same ratio with the notes they represent. Rests, being dotted, are equally affected as the notes themselves. Triple-time relates to all measures which contain three, instead of four, equal parts; and is usually known by $\frac{3}{4}$, marked at the commencement, if the measures be of three crotchets in a bar; but if of three quavers, then $\frac{3}{8}$ is prefixed; sometimes we have $\frac{9}{8}$, which implies nine quavers: this last is almost exclusively peculiar to Irish music. Regarding the above points, we refer to the explanations, No. 11, 12, 13: in the last, it will be seen that a quaver-rest fills the place of the quaver wanting in the music to complete the measure. There is also a measure called $\frac{6}{8}$, which is generally called compound common time, but which is, in fact, a species of triple time. The reason given for classing it as a common-time measure is, that the beat of the foot, *i. e.* its fall, is at the first note; and that the rise of the foot is in the middle of the bar; whereas, in all kinds of triple-time, the foot rises at the third division of each bar. This is called beating time. The letters *d* and *u*, put under the notes in the 10th, 11th, 12th, 13th, and 14th Examples, will show when the foot should fall (at *d*) and rise (at *u*). This operation is not necessary among good musicians; at all events, only one, that is, the leader of a band, should ever beat the time, and then only loud enough to govern those who accompany him. Those performers who cannot feel the measure will never be the better for its being beat into them.

Music is divided into periods and phrases, the same as poetry; it would be trespassing on the limits of our plan to insert examples of this; but every person, at all conversant in the practice of music, or who has a susceptible ear, cannot but notice, in all ballads, and other lyric compositions, &c. particular dispositions in the musical phrases to assimilate with the lines or words. This is not so much felt in the more laboured compositions, in which we too often find, that affectation of singularity, and a display of science, lead the composer to deviate from the simple dictates of nature; and to carry his audience into those sublimer regions of composition, whither the vulgar are not prepared to follow him. Bravuras, and other highly wrought compositions, are of this description: in such, the powers of some favourite performer are to be rendered conspicuous, and astonishment, rather than pleasure, is the momentary object. Such, however, essentially serve the cause of the science; for, without some points of emulation, we should be limited to ditties, dirges, and all the tribe of artless strains, which, though very pleasing in themselves, would form but an indifferent school, and by starving genius, and banishing taste, would reduce our whole stock of musical knowledge, and of musical recreation, to very narrow limits indeed.

But, although music may not be confined within the shackles of lyric intention, it, nevertheless, if worthy of the designation, is, in every part, under the influence of general rules, applied, perhaps, with less rigour, and occasionally too much neglected; but such liberties often produce most powerful effects; and, by exacting applause from mankind in general, seem to command that indulgence which theorists would peremptorily negative. The great art lays in the adaptation! Here we must remark, that several notes of the scale have very peculiar effects. The key-note always impresses forcibly, and seems most familiar to the ear: it is also very bold and commanding: the third leaves an unfinished effect, especially when minor, in which mode it assimilates greatly with the fourth, which is peculiarly querulous: the tone of the sixth is mild; as is that of the second; both these seem to have no determined effect, but, if any thing, partake of a minor tendency; that is, they are more plaintive than commanding: the fifth is bold, but inconclusive, though it evidently points to a termination; hence we find, most pauses and imperfect cadences settle on this note, which, in many situations, seems absolutely to convey some question. A perfect knowledge of the effect of all the notes in the scale is necessary to the composer, who thereon founds his melodies, and the expressions particularly applicable either to the incident or to the words. The sudden rise, or fall, of a semitone produces the most extraordinary effects on many occasions: the former may be rendered extremely pathetic, though in general augmentations in the compass of thirds, fourths, fifths, and sixths, tend rather to roughen than to soften; while, on the other hand, their diminution, and especially of a seventh, from sharp to flat, occasions a melancholy and languid change, often of the key; which, in their passing from a major to a minor mode, is highly impressive.

We trust the reader is now prepared to enter on the discussion of that important part of the science, called harmonic consonance, or the doctrine of combined sounds. This relates to what is termed harmony, or the performance of music in parts; melody being confined entirely to a succession of single sounds; such as one voice, or the sounds of a flute, or of any other instrument capable of uttering only one note at a time. Hence, when we admire an air, and find fault with the accompaniments, as being deficient in modulation, &c. we say, "the melody is pleasing; but the harmony is bad." This part of our subject relates to an immense variety, in the selection of which the greatest judgment is necessary; as will be seen from the following brief hints.

There is to every note a natural accompaniment of a third and fifth, which being sounded with it, forms what is called a common chord; the term chord applying to all those combinations of various notes, whether pleasing or otherwise, which are intended to sound at the same time. The 18th Example, displays the common chord of C, in its three positions; namely, with its fifth, G, uppermost; with its third, E, uppermost; and with the key-note, C, uppermost. When the chord is in the first position, it is called erect; in the second and third instances, it is said to be inverted; for then G, from being a fifth above, is a fourth below, and E becomes a sixth below; which is nothing more than an inverted third. The common chord is the parent of all consonances; but by the addition of a minor third (B flat) above its fifth, G, it changes its designation; being called the chord of the seventh, from which all the discords are derived. This chord, with its inversions, may be seen at Example 19. When another minor third (D flat) is added, above the flat seventh, the chord is then called the chord of flat ninth and seventh; of which the figure and inversions may be seen at Example 20th. But this chord, though often found completely filled in full pieces, requires, in general, some deductions, such as the omission of the third and fifth: so that the discordant parts may be more fully heard, and more sensibly devolve upon a perfect harmony; as seen at Example 21st, where the third E, and fifth G, of the chord C, are omitted, while the flat seventh, B flat, and the flat ninth, D flat, each fall a semitone into the perfect chord of F, C itself rises into F, and becomes the key-note of the new chord. This will serve to show how discords are resolved, as it is termed, into concords.

According to the strict rules of composition, every discord ought to be prepared; by which it is meant, that it should be heard as a part of some concord, before it becomes a discordant note in the succeeding chord. after which it must, as we have just shown, fall upon some accordant part in the next following chord. Thus, we find, in what is called the perfect cadence, or completion of a musical period, as at Example 22, the note F is first heard as the key-note of a common chord; in the next chord it becomes the flat seventh of G, and in the third chord it sinks one semitone into E; thus becoming the third of the common chord of C. But the ninth may be natural, and may resolve so as to become the octave of the next chord, while the seventh, which may also be natural, may resolve into the sixth; both, however, should be duly prepared: a reference to Example 23d will give a correct insight into the change thus made.

In speaking of cadences, we should remark, that various kinds exist, of which only that called the perfect is conclusive; the others, namely, the imperfect, and the false, or interrupted, leave the ear in a state of suspense. The perfect cadence is formed by the common chord of the fourth F, (to which a sixth may be added, thereby making the fifth a discord, and compelling it to descend one step in the following chord,) then the fifth of the key, G. bearing a chord of seventh, fifth, and third, which resolves into the common chord of the key-note, C: this may all be seen at Example 24, where the lowest notes show the bass notes of the cadence, and the upper ones exhibit the several changes indicated by the figures under the bass progression, as they proceed in their resolution. Observe, that the octaves above, or intermediate, are not figured. The imperfect cadence relates to that settling, for a time, which occasionally takes place on the fifth of the key, introduced by the key-note, as seen at Example 25, where, though the cadence falls on G from C, yet we feel a kind of expectation, that the music will return to the key of C, and that G will be only a temporary key.

The false or interrupted cadence is made by the bass moving, at first, the same as in the perfect cadence, namely, taking the fourth and the fifth of the key as fundamentals; but in lieu of proceeding from the fifth to the key-note, it ascends only one step into the sixth, which being accompanied by its third and fifth, and eventually by its seventh, which was prepared in the preceding chord, forms a great contact with that of the key-note, of which the ear was in expectation, may be seen at Example 26: it must be carried in mind, that the perfect cadence should always follow an interrupted one. But, whatever changes may be made, and especially in passing from one key to another, the greatest attention must be paid in preparing the ear for the variety, by the frequent or forcible introduction of some note prominent in the chord of the approaching key, especially the fifth, which is always very distinguishable. Nor should the change take place, except according to the laws of modulation, whereby it is required, that the preparation of the new key should be rendered familiar and smooth, by means of some one or more notes which may appertain thereto: thus, in Example 21, we find the key of F is introduced without any harshness, because the fundamental note, C, is the fifth of the succeeding chord. The key of G is equally easy from C, as may be seen in Example 25, on account of G being the fifth of C. The chords of the fifth and of the fourth, being so easily established from the key, are called adjuncts, they require not any preparation. The key of A minor may likewise be assumed, as it were suddenly, from the key of C, without offending the ear, because its common chord contains two notes, G and E, which are constituents of the chord of C. We also find but little objection to shifting from the key of C major to that of E minor, because the latter hastens notes in it appertaining to the common chord of C.

Music would be extremely insipid were it not that modern composers have shown with what excellent effect discords may be introduced; these serve to vary and to embellish passages, which would else be very tame, and nearly monotonous. Discords are like those bold shadows in painting, which serve to relieve the lighter parts, making them appear more brilliant and more conspicuous; they serve, like a rich sauce to an insipid viand, to give an agreeable zest to what would be scarcely tolerable. They are generally furnished, either by addition, as the added sixth to the chord of the fourth of the key; or by suspension, where, as in Example 27, the bass assumes some note contained in the chords of the second and fourth parts of the bar, while the treble keeps the sound of the former chord suspended. A chord, figured with $\frac{5}{4}$, is but a suspension of the third. The chord of the ninth is but a suspension of the eighth; the seventh often suspends the sixth, while the sixth is frequently found to suspend the fifth. The ninth, seventh, and fourth, are often found, at the same moment, suspending the eighth, sixth, and third. We have another variety, called anticipation, exactly the reverse of the foregoing; in which the upper parts get forward into the harmony of a succeeding chord, in which the bass does not immediately join, but follows in the same way that it precedes in suspensions. This is not quite so common as what we have just detailed; but, when well conducted, is full as beautiful.

In former times, when music was less understood as a science, than it is at this day, the rules, or rather the licences, for accompaniment were very limited, and confined the harmony to such a paucity of permutations, as would, among modern theorists, be considered bald and puerile. We should not tolerate such music; for the habits acquired, by frequently hearing compositions in which every possible change has been introduced, would render the inexpressive, tame, and monotonous accompaniments of those musicians, who were contemporaries with the celebrated Guido, (to whom the art is highly indebted), little more gratifying than a peal on an octave of bells. We are not, however, to suppose, that plain, simple melodies are beneath the composer's notice; far otherwise, we could quote many little strains, in which every note is attractive, and which, when duly accompanied, give the greatest delight. Perhaps Pleyel's German Hymn may, in that respect, be considered as neat a specimen as could be quoted; in it we have all the suavity of religion, without any of the dull, tedious, or tautological circumstances which characterize a large portion of church music. The variations annexed to that pleasing air are proofs of the composer's taste; while the presto which follows, and is upon the same subject as the hymn, gives a most agreeable termination, and is so managed as completely to change the character of the music.

The art of composition requires great genius, taste, judgment, a fine ear, and the utmost patience! without these, good music will never be produced. We should, at the same moment, studiously avoid the pedantic bias, too often received by men of the first abilities, whereby a certain stiffness, and deficiency of air, are sure to follow; few, indeed, have the happy gift of acquiring all the necessary attainments in the theory, and to preserve a pure taste for those lyric compositions which are so highly relished by the multitude. We have, however, seen a Rosina start from the brain of science! Yet, after all, it is frequently with some difficulty that the favourite airs of other nations gain admittance among us. With persons who can appreciate merit, and who can discover beauty even among features which may not be very regular, foreign compositions are well received; but it appears to us, that the English (speaking of the multitude) have nearly as much partiality for a peculiar style, such as the ballads of Dibdin, as the Scots have for their reels, strathspeys, &c. In fact, almost all music may be considered as national; for in every country we find either a peculiar measure, a peculiar mode of accenting, a peculiar kind of expression, or some one or more peculiar circumstances, which at once give a designation to the composition. The Irish nine-eights; the Scots reversed punctuation; the accent of the Polacca on a part of the bar we seldom or never accent; the great simplicity of the English ballad; the *naivette* of the French pastorale; the wild, yet impressive, Hindostanee air; the graceful Italian canzonette; the trifling, but cheerful, air Russe; and a variety of others, establish a certain index of national character, at least as conspicuous, and as prevalent, as the features of their various inhabitants.

The notes used in music form a kind of universal language; for, being in general use, they are equally familiar to all civilized nations: hence it is not uncommon to see several persons, who can barely make themselves understood by speech, unite in a concert, and proceed in their several parts with surprising facility and precision. The Italians for a long time had the lead in this fascinating science; and, such was the rage for the compositions of Italian masters, that an immense quantity of music, composed by the professors of other countries, was ushered into the world with Italian indications; by which means they obtained a welcome, and sometimes a celebrity, that would probably have been denied them, had their origin been discovered. These circumstances occasioned the general use of Italian terms; which, in lieu of diminishing, since other countries have been able to boast of their justly praised authors, appear to be even more prevalent than ever. The confirmed establishment of an Italian opera, at every great city, in the most polished countries of Europe, seems to have generated a *gout*, or a partiality for both the language and the representations of Italy. This has given rise also to many deceptions, particularly to the assumption of Italian names by the natives even of England. Such is the effect of opinion, that merit is sometimes obliged to disown her native soil.

We shall now furnish a brief Glossary of those terms which are commonly found in modern music, and explain a variety of little matters relating to the titles of pieces, to the degree of quickness, or of slowness, in which they should be performed, and such other minutiæ as could not have been introduced into the former parts of the subject, without breaking that connection which we have endeavoured to preserve, whereby to lead the reader, in a familiar manner, through the most essential explanations.

GLOSSARY.

A *sonata* is a piece of music for instruments only: these are now chiefly for the piano-forte, either with or without accompaniments for a flute, or violin, or a violoncello; or, eventually, with numerous accompaniments.

A *cantata* is a piece set to words, and is often interspersed with recitative; some of these are medleys, and are very long.

A *motetto* is generally considered as church music, such as our anthems, hymns, &c. or any single pieces of a sacred character.

An *opera* is a dramatic poem, in which many airs, of various descriptions, arising from the incidents of the piece, are sung to the accompaniments of a full orchestra. Such as are performed at our Opera House are throughout musical, being wholly a succession of recitative, airs, duets, choruses, &c. performed in character. Opera also signifies a work; as Opera VI.

A *burletta* is a comic opera, in contradistinction to the serious.

A *ballet* is a dance in character, which, however ridiculous, is admitted and applauded, chiefly on account of the excellence of the performance.

An *oratorio*, a sacred drama, of which the words are generally selected from the scriptures; they are performed during Lent at Covent Garden Theatre.

A *concerto* is a grand piece of harmony, generally on some given subject, with full accompaniments, which join only in the choruses, though a select number of parts are allotted, to accompany the instrument which is intended to be displayed. The principal instrument on such occasions is termed the concutante, as violino principale, or fluto concutante.

A *concutante* is intended chiefly to display one instrument, but not without allowing others to be brought into particular notice at times.

A *voluntary* is a piece of music usually resulting from fancy, an extempore effusion; it is not a regular performance, and is neither fixed to any particular key, nor limited as to time; these are sometimes termed fantazias, capricias, ricatatas, tastaturas, &c.

A *sereniade*, or *serenata*, was formerly meant to denote nocturnal music, but is sometimes prefixed to dramatic compositions, without any particular meaning; the term is nearly obsolete with us, though it occasionally occurs in novels, &c.

A *saraband* is a piece in three-fourth time, generally played slow, and in a dancing stile; it is nearly the same as our ball minuet.

A *fugue* is a piece wherein one or more subjects always appear to fly in some conspicuous manner, and to be followed by the several parts in succession. There are single, double, and counter fugues; the latter moving in an opposite direction to the others.

A *canon* is a fugue which always returns to its subject; so that the several parts perform the same passages in succession: a canon may be kept up perpetually.

A *solo* is a piece intended for the exercise or display of some particular instrument; though in its correct sense it is music in one part only, yet generally figured basses are annexed; and to a solo concerto, very full accompaniments are given; in these we usually see the most difficult passages for that violin, flute, &c. which leads throughout, and which should be supported with great delicacy and judgment.

A *duo* is a composition intended for two voices or instruments; these are also called duets; when replete with brilliant passages intermixed in the two parts, they are dignified with the additional term of concutantes.

A *trio* is music composed in three parts, either for voices or for instruments; it is also a designation given to a second or alternate minuet.

A *quatuor*, or *quartett*, is music in four parts.

A *quintetto* is music in five parts.

A *sutetto* is music in six parts.

An *overture* is either incidental or periodical; the former relates to those rich pieces, for a full orchestra, usually preceding the representation of musical entertainments; the latter are intended for the same purposes, but not for any particular opera, and are suitable to grand entertainments, for the opening of acts, &c.

Sinfonia, or *symphony*, usually relates to the few bars of preparation which are played as a prelude to songs, &c. to prepare the audience, and to give the singer the proper pitch for his voice—little symphonies are also occasionally interspersed throughout, either as graces or as a relief to the singer, after exertion especially; they are, for the same purpose, added after every verse of a song. The word sinfonia is synonymous with overture, when prefixed to a piece of many parts.

A *cadenza*, or *cadence*, is that flourish made arbitrarily by a vocal performer, or by a leading instrument, while the whole of the other parts stop, at a pause. The cadence is quite an *ad libitum* passage, and usually is not written; the performer being left to deviate according to fancy, and without restriction as to measure, or to any key; he may modulate to any extent; but, when he closes, must return to that note on which the cadence is founded. When cadences are written, they are never divided by bars, like the rest of the measure.

A *march*, or *marcia*, is a military air in common time, and in a pompous majestic stile.

A *gavot* is a moderately lively air, in common time, commencing with a half bar.

A *caccia*, or *chase*, is usually in six-eighth time, in a hunting stile.

An *allemand* is a slow dancing air, in common time; in which the parts of the strain are always repeated.

The *hornpipe*, *rigadoon*, *cotillion*, *waltz*, &c. are various kinds of dances, in rather a slow time, so as to admit of much grace; while the jig, the reel, the country-dance, &c. are more active amusements, and require less finish from the dancing master.

The *minuet* is a slow dancing air in three-fourth time; but is now out of use, except at court, and formal entertainments. The minuets in overtures, &c. are now generally performed quick; some, indeed, are absolutely prestos.

These have usually trios or alternate minuets annexed; after the performance of which, the minuet itself is always played through without repeats. These minuets are not restricted to any number of bars; but the dancing minuet is invariably limited to two stanzas or strains of eight bars each.

The *rondeau* is a piece in which the theme is often repeated, and generally forms the main burden; it always ends the piece.

Recitative is a peculiar mode of reciting words set to music in a kind of chant, that partly allows the sense to be expressed; the accompaniment of a recitative is often very rich, though sparingly given, and requires the greatest judgment to execute with propriety.

Score is the notation of the several vocal and instrumental parts of a piece in various staves, one under the other, bar for bar; so that the whole effect may be seen at one view, while each part occupies its own stave separately. The score is the manner in which the composer sets out the several parts; from it they are afterwards transcribed by copyists into the different books respectively.

Counterpoint is the art of arranging parts to any piece of music, taking them from a figured bass; though some expert composers form the bass as they proceed. To be a good contrapunctist, a thorough knowledge of harmony, of modulation, and of the effect of certain combinations, as well of instruments as of notes, are absolutely necessary. Many a person may possess very superior skill in counterpoint, who has no genius for the invention of good melody. Above all things the contrapunctist must avoid consecutive fifths and octaves in the same parts; however, a perfect and an imperfect fifth may follow. The reader will easily comprehend what we mean by consecutive fifths, when we refer him to the sounds of the open strings A and D on the violin, &c.; these are fifths—now, if the finger be laid on those two strings, so as to produce E natural, and B natural, those two notes, being also fifths, cannot follow in any two parts; for although fifths are the third stage of harmony (octaves being the first, thirds and sixths the second) yet, when two parts proceed in a parallel of fifths, one for instance playing A B C D, while the other plays the D E F G below, the effect is harsh and inharmonious.

We shall now state the regular degrees of slowness and of quickness, in the execution of music, according to the directions given by the following Italian words, which are chiefly in use.

Adagio, adagio, very slow.

Adagio, slow, in an easy leisure manner.

Largo, or *leuto*, giving full time to express each part of the measure.

Larghetto, not quite so slow as largo or leuto.

Andante, with perfect distinctness, and moderately slow.

Andantino, not quite so slow as andante.

Allegretto, or *poco allegro*, or *vivace*, in rather a free manner, but not quick.

Allegro, moderately quick.

Presto, quick.

Prestissimo, very quick, in a hurried manner; in fact, as quick as you can follow the notes.

Conumodo, according to your own convenience.

Spiritoso, or *con spirito*, in a spirited manner.

Con vio, with vivacity.

Brillante, in a gay, rich, ornamented, and brilliant stile of execution.

Agitato, in an agitated broken manner.

Siciliana, a peculiar pathetic manner of performing six-eighth time.

Pastorale, in a pastoral ballad stile.

Timoroso, in a fearful or timid manner.

Affetuoso, in a plaintive affecting manner.

Amoroso, in an amorous or tender stile.

Animato, bold and dashing.

Cantibile, in a singing manner, but not faster than andante, or an andantino.

Macetoso, or *pomposo*, in a majestic or pompous manner.

Grazioso, gracefully, this term is very often mis-spelt, whereby it produces a very different effect, being then

Gratioso, which signifies a harsh rough manner, and is peculiarly applicable to those scenes of acute distress, devastation, and phrenzy, which are occasionally represented on the stage.

Larmoyante, or *doloroso*, in a weeping sorrowful manner.

Piano, or *p*, or *pin piano*, or *p p*, these indicate a low soft manner; the word pin inclining to the extreme, in contradistinction to

Poco, which means only a little, or rather as poco allegro, rather allegro.

Forte signifies strong and firm.

Fortissimo, or *forte forte*, or *f f*, in the strongest manner.

Mezzo, signifies middling, as mezzo soprano, a middle soprano; or *m f*, mezzo forte, middling strong.

Dolce, soft and pleasing, as dolce expressivo, to be expressed in a touching soft manner.

Ma, but.

Non, not.

Troppo, too much.

Men, less, as menforte, less strong.

Quasi, rather, or like; “ andante, quasi allegretto; ma non troppo.” “ Andante, inclining to allegretto; but not quite so fast” (as allegretto.)

Con, with, as con giusto, with taste.

Seuza, without, as seuza sordini, without sordini (or mutes.)

Crescendo, increasing in force.

Diminuendo, decreasing in force.

Accelerando, quickening in time, but gradually.

Rellentando, or *ritardando*, becoming slower, but gradually.

Rinforza, or *r f*, or *rinf*, to reinforce that particular note.

Assai, enough, as allegro assai, rather more than less than allegro.

Stoccato, means to sound each note distinctly.

Loco, we sometimes see music marked to be played an octave higher or lower than octave minim; with a waved line over the passage to be thus raised or depressed, when the word loco, or a loco, directs the music to be played at that exact pitch wherein it is written.

Arpeggio is a mode of playing the notes of a chord in succession, so as to imitate the sounds of a harp; of this a specimen is given in Example 33, where the chord of C natural is arpeggioed in various ways.

Syncopation is a peculiar manner of diving (as it is termed) one note into another; thus, at Example 34, a bar appears to be made of one quaver, three crotchets, and one quaver; if these be all played as they are written, at the same time giving the whole a kind of half-slur, the syncopeted effect will be produced.

Appoggiatura is the introduction of a grace, not included in the amount of the measure in a bar; but which is to be deducted from the note to which it is connected by a little curved line, as seen at Example 35; the performance of which is explained at 36. In this example it much resembles a brief syncopation; the appoggiaturas, and indeed all graces, are usually in very small notes.

Tempo, or *tempo piana*, after accelerando, or retardando, or rellentando, this directs the music to be resumed in its original time.

Pause, or *point d'orgue*, marked by a semicircle, see Example 25 (above or below a note), with a dot in its centre, implies a rest of all the parts, or a cadence.

Tutti means that the whole band should join; as in the reinforcing parts of concertos, &c. Tutta forza means “ with all your force.”

Fin, or *fine*, shews where the piece, or that division of it, ends.

Da capo, or D C, means that you should begin again at the head of the piece, and proceed until you come to fine. This is one of the signs of a repeat, and is usually accompanied by a figure resembling an S, with a stroke through it perpendicularly, and with two large dots on each side, see 31; so often as you see this mark, it refers you to the beginning, or subject, or to such part as has a similar figure prefixed, and terminates either with fine, or with a point d'orgue, which in such case is a final.

There are various kinds of repeats, as follow: the single preceding repeat, see 28, is known by a strong double bar, crossing the stave, in the same manner as those single bars which divide the measure into equal portions, and dotted with two or more large dots to the left. The single succeeding repeat is known by two or more dots to the right of the double bar, see 29. The double repeat is dotted on both sides of the double bar, see 30, and directs, that both the preceding and the following parts should be repeated. Whereas, where the bars are dotted only to the left, only the preceding part is to be repeated; and *vice versa*.

Mostra, or *direct*, is placed in a half bar ending a line, to shew what is the first note in the next line, see 32.

Bravura means a highly worked composition, in which the vocal performer is expected to execute difficult passages with great skill and propriety of expression.

MUSICAL *Instruments*. Notwithstanding the great number of instruments in use, and the vast alterations that have within these few years taken place in their construction, yet we cannot boast of much originality; nor can we assert, that so much improvement has been made in this branch of mechanism, as the theory and practice of music have received since the time of Guido, or even of the justly famous John de Murio. A retrospect of ancient dates will convince the inquisitive reader, that what we now term inventions are, with very few exceptions, plagiarisms from the common practices of musicians, &c. at a very remote period; some may be correctly traced to several centuries before the Christian era. In describing the instruments in modern use, we shall deduce their respective genealogies, and shew that many, which, by the best accounts we can obtain, were in high reputation among the Greeks and other nations, have, like the secret of rendering glass malleable, been altogether committed to oblivion. Of a few we have, indeed, an imperfect idéa, furnished to us by some antique medals, bearing figures of musical instruments now unknown; but of which only the form can be thus understood; their intonations remain concealed.

We shall endeavour to detail the various instruments, of which we are about to furnish a concise description, in such a manner as may at once establish a regular system, and enable the reader to proceed with his investigation in a familiar and satisfactory manner. The first step towards this important point is, to form them into classes, as follow:

First Class. Instruments of percussion, whether pulsatile, as a drum, or as a piano-forte; or plectrated, as a guitar, or a harp, or a harpsichord, &c.

Second Class. Instruments of inflation; such as the organ, trumpet, flute, &c.

Third Class. Instruments of collision; such as the violin, and the celestina.

Our plan will be, in the first instance, to describe those instruments which are now in general use, together with their modern varieties, and to point out the ancient instruments from which they appear to have originated. Thus, considering it to be the principal and most popular of the first class, *viz*. of percussion, we shall begin with.

The Grand Piano-Forte. This admirable instrument resembles the harpsichord in form, but its action and tone are far superior. Its wires run longitudinally along the belly, or sounding board, supported at about two-thirds of an inch distance by small low curved battens of beech, or other wood, on which are short pins, firmly driven into the battens, for the purpose of keeping the wires perfectly parallel. These battens, which are called bridges, determine the lengths of the several wires; though the latter pass beyond them for some distance; being looped on at their further ends to stout pins, driven firmly into a solid part of the frame-work, and coming over that bridge which is next to the keys, with which it is parallel, and winding on a set of iron pegs; which, being driven deep into a solid block of hard wood, are turned either right or left by means of a small instrument called a tuning-hammer, and are thus tightened or relaxed at pleasure. The shortest wires are the thinnest, these lie to the right, and give the upper notes. The largest wires are to the left, and give the lowest notes: those between them are longer or shorter, according to their situation, their several lengths increasing as they approach towards the left side of the instrument; forming, by means of the bridges, which lay obliquely, a triangular figure. Each note has three wires, lying within, rather less than half an inch in breadth; these are equidistant, and proceed to three rows of tuning pins, so that the tuner cannot mistake as to which of the three wires he acts upon. The wires are chiefly imported from Germany; our artisans not having as yet acquired the mode of giving them a due degree of temper. Those of the higher notes are of brass, and commonly begin with No. 8, 9, or 10, gradually increasing in thickness until they reach the extent of about four octaves, when they give place to copper wires, which produce a deeper sound. A few years back, piano-fortes rarely exceeded four octaves and a half, or at most five; but, latterly, they have been very generally manufactured with what are termed additional keys; which extend the compass upwards from F in alt, to double C in alt. Mr. Kirkman, of Broad-street, Soho, further extended the compass downwards, from double F to double C, giving a greater and a much richer scope of bass. But such additions, necessarily increasing both the size of the instrument and its powers, disqualifies those so constructed from adaptation to small rooms. To remedy this, grand piano-fortes have been made in a vertical form, so as to resemble book-cases, &c.; they answer well, but in general overpower a weak voice: their convenience is obvious.

The wires of the piano are made to sound by means of small wooden levers, called hammers, each of which has a rising projection at its end, covered with many folds of leather, so as to produce a clear tone. These hammers are impelled upwards by means of the keys, which being depressed by the fingers, and balancing on small flat battens, on which they are arranged, and kept steady by strong pins passing through near the points of equilibrium; also having little knobs of pump-leather standing on stems of wire, at their inner ends, cause the levers to rise on the least touch of the finger, with a smart stroke, so as just to touch the three wires of their respective notes. The levers being fixed to a frame, parallel with the keys, by means of vellum hinges, return instantly to their places, and lay on a small parallel apron covered with baize, so that no rattling nor jingling results from their retrocession. These hammers may be distinctly seen when working, as they pass through a broad slit made in the sounding-board, the whole breadth of the instrument. At the inner extremities of the keys are small pieces of buff-leather, which take off the sound that would else proceed from their contact with the shafts of the dampers; which are contrivances for stopping the tones of such wires as are struck by the hammers, so soon as the finger is taken off from the key. The devices for damping, as it is technically called, have been numerous; and their several inventors have never failed to uphold their own modes, as the *ne plus ultra* of ingenuity. It would, perhaps, be impossible to detail their several merits with any show of utility to the reader, or with impartiality to the inventors: if, however, simplicity of construction, certainty of action, and facility of repair, may give a claim to pre-eminence, the common balance-damper may assuredly urge its pretensions to the palm. This is nothing more than a round stem, like a small cedar-pencil, which is crossed at right angles by a flat bar, one of whose ends is slit, so that it may be guided by a slender perpendicular pin, as it rises, in consequence of the key's pressure upwards; at the other end is a small piece of broad cloth, single or double, according to the powers of the wire (the longest vibrating most forcibly). This little piece of cloth, by falling on the wire when the key is released, instantly stops the sound. The reader will, from this description, collect, that when slow passages are played, the continuance of each note is in exact ratio with the time of the key's being kept down; and that, in rapid passages, where the touches are light and transient, even defying the quickest eye to follow the movements of the fingers, the operation of the dampers must be as rapid as that of the hammers, else a confusion of tones will be heard.

Most grand piano-fortes have two pedals, one for each foot, communicating with the interior. One serves to raise all the dampers completely, which in tuning is a considerable convenience; the other serves to throw the whole of the key-frame to the right, more or less; by this means the hammers are slid at the same moment, in a body, about a quarter of an inch to the right; so as to quit either one or two, at pleasure, of the left hand wires of each note; and to strike upon only one, or two, as judged proper for the greater or less diminution of sound. Other pedals are sometimes affixed, for the purpose of opening a kind of flat cover, like Venetian blinds, laying over the wires, thereby to allow more or less sound to pass. The sounding-board, or belly, is made of very fine narrow deals, chiefly imported from the continent, so closely joined that, in many, no line, or indication of junction, can be distinguished. This belly returns the sound, causing it to reverberate very forcibly. The long keys are exteriorly covered with ivory plates; and the semitones, or sharp and flat keys, are made of ebony: they stand higher, but are nearly two inches shorter than the keys of the natural notes.

The *Harpsichord* is of the plectrated species, whereas the piano-forte is of the pulsatile. The former resembles the grand piano-forte in every instance, excepting that, in lieu of hammers, it has jacks; which, rising perpendicularly, pass the wires, and by means of short pieces of stiff quill, projecting from their sides, displace the wires from their right lines, and consequently cause them to sound so soon as the quills have passed. The dampers of the harpsichords are on the jacks. This instrument is partly derived from the polyplectrum of Guido.

The *Square Piano-Forte* is very different in form from the grand. It, however, has an action, or movements, nearly similar. Its belly is short, and the bridge, or the sounding board, is rather curved. In some the tuning-pegs, which are four or five in a line, form a kind of column on the right; in others they are immediately beyond that bridge which is nearly parallel with the keys. Each note has two wires; those in alt, and indeed, down to G on the clef-line, are usually steel, from No. 8 to 12; the middle notes have brass wire; about half an octave of the brass part is furnished with copper; and the eight or ten lowest notes are of brass wire, on which a thinner wire of the same metal is wound in an open spiral manner; whereby a deep tone is produced. A patent has lately been taken out, by a manufacturer in Golden-square, for bass notes, formed entirely of spiral wires. This is founded on the principle of increased length giving an increase of tone: these bass notes are, no doubt, louder than those on the common construction, but it remains to be ascertained how far they can bear comparison with them in other essential qualities. The square piano-fortes are made with pedals, but not for sliding the keys and removing the hammers laterally. That could not be done to any purpose in this instrument; as the wires, instead of receding from the player in a perpendicular line with the keys, lie across at nearly right angles. One pedal is all that is necessary, namely, to raise the dampers while tuning. Many young ladies raise the dampers while playing, for the purpose of increasing the sound; they certainly succeed: and, at the same time, produce an abominable jargon, highly offensive to a good ear; and, in general, a sure proof of the want of a delicate finger, and of judicious expression.

We have one species of the piano-forte of which the notes are formed by collision; this is the *Celestina*, whose remarkably soft and fascinating tones result from the passage of silken lines over its wires. The action of this instrument cannot easily be described in writing; we will, therefore, pass on to the consideration of the

Spinet. This is a plectrated instrument; its shape is not much unlike a harp laid horizontally. It is cased the same as a piano-forte: the notes have double wires, almost wholly of steel, there being but few of brass; they are touched by jacks, as in the harpsichord; and, like it, the tones are very wiry and rough. Its compass is rarely more than four octaves, or at most five. This instrument is completely out of vogue: such as we now see are, in general, from 25 to 50 years old. It evidently was the parent of the harpsichord, as that was of the several kinds of piano-fortes.

Beyond the spinet we find the *Virginal*, which for a long time stood its ground. The citole, which was a little box, with wires on its lid. The magadis, which had its notes turned in octaves. And the clarichord, or dumb-spinet, which was much used in nunneries, having its wires wound round with silk; it yielded a peculiarly soft, but low sound. This instrument seems to have been in vogue for a great while; though now extremely scarce, and only to be found in religious institutions on the Continent.

We must do the English manufacturers of the present age the justice of saying, that, for power and clearness of tone, freedom and certainty of motion, elegance of finish, facility of touch, and standing in tune, they stand unrivalled throughout Europe. The names of Tomkinson and Kirkman, for grand pianos, and of Clementi and Broadwood, for square pianos, stand eminently conspicuous in this branch of mechanism; but to obtain excellent instruments, even of their make, application should be made to them, and not to the paltry retailers of a few; which, though made by those manufacturers, are of a very inferior description, suited to the low prices paid by such advertising gentry.

The *Harp* next claims our notice: its form and manner of performance being so well known, require but little description. The name of this instrument is supposed to be derived from the Arpi, a people of Italy, to whom its invention is, by many attributed; though others assert that the Arpi received it from the Irish. The Hebrew harp was said to be remarkable for its beauty, and for the great extent of its scale; the latter was supposed to surpass that of the modern harp, which does not exceed five octaves. Ours is always tuned to the same pitch, generally E flat, and its semitones are made by a number of pedals, placed round the base, or plinth, on which it stands; these communicate with the top-piece by means of a hollow column in front of the strings; on being pressed by the foot, they cause the strings (which are chiefly made of what is usually called cat-gut, the gravest being of flock-silk, covered with fine wire) to be shortened by projecting tops, and thus to give a tolerable chromatic effect. The Irish, and the Welsh, used to be famous for their performance on the harp; but, at present, only a few itinerant bards are to be found in those countries: these preserve the tradition of many very appropriate national airs; but their execution is not to be compared with those of our great masters: nor are their harps to be rated with those superb instruments made by our best manufacturers, Evard, Erat, &c.

The antiquity of the harp appears to be as remote as it is certain. The psaltery, called by the ancient Hebrews the nebel, seems to have been a kind of harp. The simi-cum of the ancient Greeks was of this species also. The epigonum was of very ancient date, beyond what we can trace; it had forty strings; but its scale is certainly lost. The tripodian, invented by Pythagoras the Racynthian, was a species of harp, on which three different keys, or modes, were prepared: by turning the tripod round with the foot, either side could be presented to the performer, who changed his key at pleasure. A vase at the top answered the purpose of a sounding-board.

The *Guitar*, or *Cittern*, is much in use among the Spaniards, and their neighbours; it was also in vogue with us many years back; when some improvements were made, particularly the addition of six keys, corresponding with the six wires; these were called boxed guitars, and by some, piano-forte-guitars. The instrument, as we see it in England, has a broad neck, on which are various frets, made of wires, fixed into the finger-board, at right angles with the wires; these being the guides for the fingers to make the several notes, by pressing between the frets; the bridge is very low, and stands behind a circular sound-hole, covered with an ornamented and perforated plate; the body of the guitar is of an oval form, the sides perpendicular to the belly and back. This instrument is strung peculiarly: the upper open note, G, is of double steel wires, about No. 4; the second, E, is also double, No. 5; the third is of brass, double, and gives C; the fourth is double, of brass, and gives G, an octave below the upper wires; the fifth is E, an octave below the second wires; and the sixth is C, the octave below the third. The two last are single wires, covered with very fine wire as closely as possible, like the fourth strings of violins. The wires loop at the bottom to little ivory studs, and at the top to small steel studs, moving in grooves, each of them winding up with a watch-key, so as to put them in tune respectively. The Spanish guitar is strung with cat-gut partly; but the lower notes are, like those of the harp, made of floss silk, covered very closely with fine wire.

There has been a late invention of what is called a *Harp Guitar*, but it does not seem to merit the name of an improvement. The compass of the instrument is increased by some long strings; but it appears to us, that the simplicity, which is the characteristic of the guitar, is thus unnecessarily violated. We have few, if any, makers or performers of note in this branch; though some ladies sweep the notes with considerable grace and effect. The plectrum is out of use; the thumb and fingers of the right hand touching the strings while the fingers of the left move among the frets.

This genus of instruments includes an immense variety, chiefly of very remote antiquity; the name of the guitar, we are confident, was borrowed, not as some assert from the Spanish, nor from the Latin cithara; but from the very ancient Hindu word sittarah, or sittar, which exclusively applies to an instrument with a very long neck, and mounted with four very small steel wires passing over a low bridge, that stands on a piece of tough untanned sheep's skin, spread over the surface of half a gourd or callibash. We have every reason to suppose the sittar was unknown in Europe until Alexander visited India. The scale of the sittar is very confined, though the performers do not neglect the scope given by the neck, which is nearly a yard long, and about an inch and a quarter in breadth, to produce many very unpleasant notes, high in alt, on the first wire: sliding their forefingers up as high as they can reach, and shifting with one finger only, among the frets, which are extremely numerous. The octachord, or lyre, of Pythagoras, had but eight notes; the pandoron was also of the lute kind; the bandora was the same: the chelys was more like our modern guitar; the theorbo, or arch-lute, is still in use in Italy, and seems to have been the basis of the harp guitar before mentioned. It has, however, two necks, of which the longest is appropriated to the bass-notes: if we are correctly informed, it is extremely difficult to perform well on the theorbo; but the sweetness of its tones compensates for the trouble of attaining perfection. The lute much resembles the guitar, and is supposed to be equally ancient; it has six rows of strings, and is performed like the rest of this genus.

The lyre is held to be even more ancient than the sittar; though we have little or no information whereon we can depend, as to its scale, or its mode of performance. This instrument is seen on many ancient coins and statues, especially of Apollo. We have several fabulous accounts of its origin, and of improvements in days of yore; but we cannot take upon us to follow the track of a long list of heathens, to whom much merit in this particular has been ascribed, since no benefit or particular gratification would result to the generality of our readers, nor would the instrument be better described, for it is a known truth, that all our acquaintance with it is from representation only.

We now come to the *Dulcimer;* it is nothing more than a small triangular flat box, in which is a shallow sounding board, having two bridges that approximate to each other as they retire from the performer. Over these bridges the wires are stretched in the usual way. The mode of performance is by means of two little sticks, armed with small knobs, partly of cork, and partly of hard wood, so as to make the tone more or less soft; it is at the utmost but a low sounding instrument, though of a pleasant tone. The scale is various, but commonly about three octaves; some have double wires. The people in the northern part of Hindostan have a kind of dulcimer made of flat steel bars, varying from two feet to only a few inches in length; these are all fixed by means of wedges into a slit between two battens, and protrude horizontally over a small box, which serves as a sounding board. The note of each is necessarily fixed, so that this instrument is always in tune. The sounds are produced either by a kind of plectrum, applied to the ends of the bars; or they may be touched by small knobbed sticks. Many of the natives in that part perform the common airs of Hindostan very pleasingly on this kind of dulcimer. The tones are not unlike those of very small chimes. The sticado, or rigots, is of this species, and consists of a long wedge-formed box, at the bottom of which two ridges are made longitudinally; on these narrow flat pieces of sonorous wood, of glass, or of metal, flat below and arched above, are placed side by side, but not in contact; so that the longest pieces from the lowest notes gradually become more acute, as the pieces are shorter towards the narrow end of the box. The notes of this instrument are produced like the former: the scale varies; but rarely exceeds two octaves and a half. The tones are peculiarly articulate, whence many have erroneously called it the stoccato: and as it was formerly much in use among rustics, who could easily construct the whole apparatus, the additional designation of pastorale was given.

The *Musical-Glasses*, when touched with sticks, resemble this instrument more than any other. The glasses are of various sizes, according to the grave or acute notes they are to yield. Some sets are well in tune, but others require to have more or less water poured in, to bring them to their proper pitch. Some performers execute difficult pieces with wonderful adroitness, though but very few can produce the rim tone, *i. e.* by touching the rims with their fingers' ends, so quick and so effectually, as to vie, in point of execution, with the sticado mode. The cistrum, or citron, was an instrument of this species, formerly in use among the Egyptian priests; we do not know sufficient of it to give any particular description, though it appears to be the parent of this genus.

Bells, *Chimes*, *Carillons*, &c. also appertain to the class of percussion, they being all struck, either by clappers suspended within them, or by hammers from without. We have some excellent bells in various parts of England; but very few chimes, and those few so vilely regulated, as to become a disgrace to their keepers, and a nuisance to the public. On the continent the chimes of many churches are objects of admiration. We may often be well entertained with the carillons, sometimes suspended over the cages of squirrels, &c.; which being touched by small projecting wires on the circular cage, the same as is done for notes on a barrel-organ, produce a pleasing effect, especially when they are either touched in succession, like a peal of bells, or are made to perform some little air.

The most sonorous instrument of this class is the *Gong*, in general use throughout China, and occasionally to be seen in other parts of Asia. Some of these immense, round, flat masses of bell metal, or other mixture, measure nearly a yard in diameter, and weigh seven or eight hundred weight; we have indeed heard of them much larger. In a still day, their sounds may be heard from two to three miles very distinctly. An author of eminence observes, that the tone of the gong cannot be appreciated; but, though we admit the difficulty, we must observe, as has already been remarked under the head of Music, that every atom in nature, when at liberty, and not damped by contact with others, possesses some particular sound, replicating to some division on our scale. The gong is struck with a wooden hammer. We may consider the modern cymbals as a species of the gong; these are two plates of mixed metal, of various sizes, but generally near a foot in diameter, and about the sixth, or fifth, of an inch in thickness; cupolaed in their centres, for about three inches, so as to resound forcibly, and to fit into each hand of the performer, who usually strikes them in a passing manner to only the first and third notes of the measure. The effect of a pair of cymbals in a military band is grand; it is a powerful reinforcement to the accent, so as to render it almost impossible for the soldiers to step out of time; but, heard at a small distance, cymbals are distressing to a well-tuned ear; they are seldom, if ever, of the same intonation; and, when clashed together in the usual mechanical manner, yield a harsh and distracting sound. The nakokus is a kind of cymbal, which, hanging in pairs near the altars of the Egyptian churches, are clashed together to beat the time. The Asiatics, in their bands, and in their religious ceremonies, use diminutive cymbals, not more than three inches in diameter, and rather bell-shaped.

Of the *Drum* species we have an abundant variety. The side or military drum is well known; it is monotonous, but habit has so far reconciled us to its uses, that we consider it as a musical instrument, though it is not in strictness entitled to that designation; nor is any instrument of this description to be so classed, excepting the kettle-drum, or timbale, which being regularly tuned, the one to the key note, and the other to its fourth below, or fifth above, are satisfactorily and efficiently introduced into full bands, in which their emphasis, their powers, and their thundering roll, frequently prove very acceptable aids, and produce the richest effects. The kettle-drum derives its English name from its form, the bottom being a large semi-spherical kettle of copper, and the head being of vellum stretched on a metal hoop, which being lowered or raised at pleasure, so as to vary the internal measurement, can be tuned precisely to any given intonation. They are accounted bass-instruments, on account of their grave sounds. Though our cavalry, for many years, were generally provided with kettle-drums, yet they were not of our own invention; nor were they known in Europe before the holy wars, when they were first adopted from the Saracens, or Moors, who were accustomed to carry them, of immense bulk, suspended on either side of camels; the driver beating as the animal moved on. The Asiatic princes consider the kettle-drum as the indication of royalty; or, at least, of pre-eminent rank and power; accordingly the naugaurah, or nagarah, is even to be heard in the kobats, or musical balconies, over the gates of princes, and in all state processions: it is likewise used by the priests of the Mussulman religion, to announce the hour of prayers, &c. The designation, *i. e.* naugaurah, is to be found in Hindu manuscripts, of a much older date than any of our European records, or authenticated traditions. The musicians of Hindostan likewise use a very small pair of kettle-drums, with wooden bottoms, which they call taublahs; these are fixed in the cloth they pass around their waists, and are beat with three fingers of each hand, in a very peculiar manner, and producing very curious effects, according as the fingers are more or less protruded towards the centre of the taublah. Their note, as in our side drum, is perfectly adventitious. The bass drum, by many called the Turkish drum, is very large, and usually carried cross-ways before the performer, who beats one end with a short club, having a large knob at its end; the left hand is provided with a lighter stick, or a bunch of split rattans, &c. so as to vary the sound considerably; but only the right hand beats upon the accented parts of the measure. This instrument is derived from the Indian long-drum, called the dole, which, instead of being cylindrical, is of a barrel-form, contracting much towards the ends, which are covered with raw skins of different thickness; no stick is used, the performers beating with their fingers.

The *Tabor* is a small drum, so flat, that the two heads are not more than three inches asunder. It is only used as an accompaniment to the pipe, for dances, &c. The tambourine is a kind of drum with only one head, the other end of the hoop, which is not more than four inches in breadth, being open; the head, which is of the best parchment, is fixed to an iron rim, and by means of screws fixed to the exterior of the hoop, can be tightened at pleasure. The performer puts the thumb of his left hand through a hole in the hoop, lined with an ivory, moveable bush or box, to prevent chafing. In this manner he whirls the tambourine about, and makes the brass jingles, or cymbals, (as they are called) which are inserted in pairs, through slits in the hoop, strike so as to produce various sounds, either clashing or tremulous, according as he may apply his right hand. The performer should have plenty of well pulverized resin strewed on the face of the tambourine, so that when he rolls, by means of the tip of a finger being rubbed thereon, the instrument may sound well. The military tambourines have generally an iron bar across the interior, furnished with bells of various sorts and sizes. This instrument was for some years much in vogue among the English ladies, as an accompaniment, jointly with a triangle, for the piano-forte. It is not easy to account for so heterogeneous an assemblage, unless in the opportunity afforded of displaying symmetry of form and graceful action. The good sense of the sex, however, speedily dismissed so absurd a combination, and allowed our ears to be again delighted with the purity of harmony, supporting the melody of a fine voice.—Though the term tambourine would imply it to be of French invention, and to mean only a little drum, we are rather disposed to believe it originated in the coonjery, which is extremely like it, though smaller, and has been in common use throughout Asia for centuries, and which probably received its designation from being always employed among a tribe, called the Coonjoors, or Sampareahs, who get a livelihood by catching and showing snakes. It is beat with the fingers of the right hand; and in possession of a good performer, yields a variety of intonations, far from disagreeable, and partly caused by the pressure of the finger of the left hand, by which it is held. This instrument rarely exceeds nine inches in diameter, nor is the hoop usually more than three inches broad, generally less; the head is either of bladder, or of raw kid-skin scraped extremely thin. The ancients had drums of various descriptions; such as the timbrel, which appears to have much resembled the common Asiatic long-drum, or dole; and the minaghinim, which cannot be classed with any other instrument, it being a hollowed board, over which a chain was stretched, and which, passing through balls of iron, &c. was beat, and swung round, so as to occasion a deafening noise.

The *Triangle* is a round steel bar, about the third of an inch thick, made into an equilateral triangle, and beat with a little piece of the same metal; it forms a passable accompaniment in a military band, and in country dances seems to give a life to the music. It appears to be of a very ancient invention, though revived only within these few years.

The *Castagnet* was originally made of two hollow chesnut shells, which, being connected by a string passing round the outside of the middle finger, were rattled together, according to the measure, while dancing, each hand having a pair. Castagnets are in general use among the Spanish women; but instead of chesnut shells, as their name indicates they should be, they are now commonly made of sonorous wood. There is another kind, made of small shin-bones of animals, of which one being held between the fore and middle fingers, and another between the middle and third fingers, they are rattled together for the same purpose.

We believe these to be all the instruments of percussion known to us, excepting, indeed, some of the most trifling, which do not merit a place in this work. The next class, namely, instruments of inflation, now comes under consideration; the principal of these is

The *Organ*, an instrument of the highest antiquity; in the structure of which the greatest ingenuity has been displayed. The reader cannot expect to find here a detailed description of so very complex an instrument; but we shall endeavour to afford such a perspicuous and general outline, as may exhibit the principal parts sufficiently for his purpose. The most difficult to make properly is the wind-chest, which is an extensive, horizontal box, so closely fitted and prepared, as to retain the wind impelled into it by various large bellows, which must be numerous, and capacious in proportion to the size of the wind-chest. The quantity of wind in it is always known to the organist by means of a tell-tale, or index, which rises and falls in proportion thereto. The top of the wind-chest is bored with several lines of apertures, proportioned to the sizes of the pipes they are to receive, those of the bass notes being the largest; but all the pipes in each row being different as to their interior construction, and consequently producing very different sounds, each row is called a stop, and has a plug appropriate thereto, acting upon a slide, which shuts or opens the whole of that row at pleasure; and is called a register. There are as many of such rows of apertures or registers, as there are kinds of tone or stops in the organ: some having few, others having numerous stops. The wind is prevented escaping from the wind-chest into the pipes by valves, which are opened only when the performer presses the keys respectively; when, by means of communicating wires, the valves are pressed down, and the wind passes into the pipes. When the key is quitted, the pressure of the wind, aided by a spiral wire spring, shuts the valve, and that sound of the pipe instantly ceases. In order to regulate the force of the sound, most church organs have either two or three rows of keys, whereby a greater or less number of pipes may be filled, and the powers of the instrument be controlled into what is called the small organ, or let loose so as to become the full organ. The pipes suited to the higher notes are made of mixed metals, chiefly grain tin and lead; they increase in length and diameter in proportion to the note; until, metal pipes being no further applicable, square ones of wood are substituted in their stead for all the lower notes. The dimensions of all the pipes of an organ are regulated by a scale or diapason, formed for the use of manufacturers in this line, and apportioned to every size of instrument usually made. Many designate the organ according to the length of its lowest note, *i. e.* a sixteen, a twelve, or an eight foot organ, such being the dimensions of the main wooden pipe. Some organs have been built on the continent, whose powers were immense, causing the largest cathedrals to vibrate sensibly with their sounds. The following are the stops usually made in a great organ: The open diapason, in which all the pipes are open at the top; this is a metallic stop. The stopped diapason; the bass notes of this, up to the tenor C, are always made of wood, and are stopped at their summits with wooden plugs, whereby the tone is very much softened. The principal is the middle stop, and serves, when tuned, as the basis for tuning all the other parts, above and below; it is metallic. The twelfth is metallic also, and derives its name from being a twelfth, or an octave and a half above the diapason. The fifteenth, so called, because it is two octaves above the diapason. The sesquialtera, composed of various pipes, tuned in the parts of the common chord; the upper part is often called the cornet. The furniture stop is very shrill, and in some passages has a peculiar fine effect. The trumpet is a metallic stop, and derives its name from the instrument it so admirably imitates; this peculiar tone is produced by means of what is called a reed, but is in reality a piece of brass, on which the wind acts forcibly, giving a roughness to the sound, which is further changed by all the pipes of this stop having bell mouths like trumpets. The clarion is a reed stop also, but an octave higher than the trumpet; it is only suited to a full chorus. The tierce is only employed in the full organ, it being very shrill, and a third above the fifteenth. The octave above the twelfth is too shrill to be used but in the full organ. The cornet is a treble stop. The dulcimer takes its name from the sweetness of its tones. The flute is named from the instrument it imitates, as are the bassoon, voxhumana, hautboy, and cremona, or krumhorn, stops. The proper adaptation of the several stops in the performance of sacred music, and in accompanying a choir, requires both judgment and experience. The fingering of the organ is precisely the same as that of the piano-forte, so far as relates to the situation of the keys, &c.; but on account of the great number of holding notes in organ music, the fingers are more kept down, whence it is considered highly injurious to piano-forte performers to practise the organ, they being subject to lose that lightness, and that delicacy of touch, required for the former instrument.

Organs are likewise made without keys, but with barrels, on which are a great number of pins and staples of flat brass wire, and of different lengths. The barrel being turned by means of a crank or winch, the wires that communicate with the valves in the wind-chest are acted upon by the pins and staples; which hold down the valves for a longer or a shorter time, according to the duration of the notes they respectively govern. On these barrels, which are made to shift at pleasure, from ten to fifteen tunes are usually made, by the foregoing means. The winch not only turns the barrel, but also works a pair of bellows, by which the wind-chest is applied. This instrument is called the hand, or barrel-organ, and is very common in our streets. See ORGAN.

A very small sort is constructed with only a couple of octaves, or less, the whole apparatus fitting into a box little longer than a mahogany tea and sugar chest: this is called a bird-organ; its notes are peculiarly melodious and soft; much resembling those of the flageolet. All bird-fanciers keep one or more of this description, for the purpose of teaching canaries, bull-finches, &c. to sing popular airs.

The *Mouth Organ*, or *Pans Pipes*, are well known; being so often played as an accompaniment to organs, &c. in our streets. They are of various sizes and extent; some being nearly three octaves; a few have a chromatic scale, at least for the adjunct keys; *i. e.* those of the fourth and fifth. The tones of the mouth-organ are certainly agreeable, but are best heard at a distance; when, either as an aid to the organ, or performing pieces arranged for several mouth-organs, as is very common, they have a very pleasing effect; when played in a room, the notes are very piercing, and the sabilations are highly offensive. The antiquity of the mouth-organ seems to be fairly established; it is to be seen on most ancient coins relating to music, and above all to Pan, from whom they derived their name; that fabulous deity was usually represented with his "pipe of unequal reeds in one hand, and a shepherd's crook in the other." The simple construction of the instrument renders it highly probable, that it is of much older date than we can trace; but we may reasonably feel some surprise, that the great organ should have to boast of existence even many centuries prior to the birth of our Saviour. Organs were supposed to have been invented by Ctesibius; but as to their construction we are left under great doubts; all we can discover is, that they had many pipes, into which the wind was impelled by water. A modern author seems to infer that the air was acted upon by water, so as to be compressed, as in the air vessels of our fire engines. This, though a plausible mode of solving the doubt, does not prove completely satisfactory, because we have strong reasons for concluding, that the ancients were not acquainted with that part of our pneumatic practice. The air pump was not known until Otto de Gueriche, a consul of Magdeburgh, exhibited his inventions before the emperor and the states of Germany, in the year 1654; and the fire-engine was first invented by Zachary Greyl in 1721, improved upon by Dr. Godfrey, and gradually brought to perfection by the successive additions and inventions of Moitrell in 1725; Jacob Leufold, ditto; Neevesham in 1744, &c. &c. We are rather inclined to believe, that the air was acted upon in the ancient keras, or hydraulic organ, much in the same manner as in the French smelting furnaces, *i. e.* by water falling down a long pipe, and dashing on a large stone, placed in the centre of a small chamber at its bottom; whence the air thus drawn down, by the stream or succession of driblets, rushes into the furnaces with a violent and equable current. Whatever the mode might have been, the practice of constructing organs, whose sounds proceeded from hydraulic apparatus, appears certain, from the many records all tending precisely to the same point. The performers were termed aseulæ Plato, and Proclus, his commentator, mentions a wind instrument in use among the Greeks, which appears to have borne a strong resemblance to the modern organs; it was called panarmonium, and was so contrived, that every aperture was capable of yielding three or more sounds. The masrakitha, of the ancient Hebrews, was likewise an instrument composed of various pipes, fixed in a chest, open at top, but close at the bottom, where they had small perforations, communicating with a wind tube, into which the performer blew, stopping those pipes that were not to sound with his fingers. In the foregoing references to remote antiquity, we discover the basis of our majestic instruments; but the swell, which, by means of a slider, augments or smothers the sounds at pleasure, is the invention of modern mechanics, who have entirely brought the organ to wonderful perfection.

The *Eolian Harp* may be best included in this class; though it cannot, in every particular, be arranged therewith. It consists of a long box, in which four or more strings are stretched for its whole length, and tuned to the component parts of any common chord, such as C, E, G, C, E, G, &c.: opposite the line of the strings which stand over a slanting sounding board, are two slits, one on each side, running parallel with the entire strings. This instrument being placed opposite to a window, opened only an inch or two, the air will rush through the slits, and vibrating upon the strings, in its passage through the box, will cause a kind of tremulous murmuring repetition of the various notes. The Eolian harp is by no means a disagreeable companion when perfectly in tune. Some idea of its notes may be formed by stretching a thin violin string over the narrow slit between the upper and under compartments of a sash window: these, being generally rather open, allow the wind to pass, and will cause the string to keep perpetually humming that note it yields when plectrated or touched by a bow.

The *Trumpet*, with all its tribe, now comes under consideration. This most audible instrument is made of metal; those of silver are by far the softest in tone; but brass is in general used. The modern trumpet is very short and portable, compared with the old form of the instrument; its tone or pitch is varied by means of additional pieces called crooks, by which it may be made to accord with any given key-note It has a mouth piece, which is about an inch in diameter, concaved for the lips to act within, and closing into a very narrow tube, through which the wind passes, with considerable force, into the neck of the instrument. The trumpet is a treble instrument; but, excepting from C in the middle of the stave to its octave above, can only perform the three under notes G, E, C, and G in the bass; in the above octave it can only deviate from the key C, by a sharp fourth leading into the key of G. In saying this we speak of the instrument unaided by the hand; for by various modes of fingering within the bell, or mouth, the trumpet can be made to yield a great variety of semitones. Trumpets with slides, which suddenly lower to raise the pitch one or two notes, are capable of great execution, and may be made to yield every note and semitone within their whole compass, so as to go through all the intricate passages of solo-concertos; but to perform in such style, and, indeed, to manage the slides with tolerable accuracy, requires a faithful hand, and the greatest promptness. We have heard that some performers can reach to G in alt; and, by a peculiar mode of forming the mouth-piece, perform duets; playing two distinct parts. We have heard this done upon a French horn, with surprising distinctions and perfect intonation. Within these few years a new instrument of the trumpet species has been introduced into full bands; this is the trombone, of which there are various intonations, *viz.* the bass, the tenor, and the alto. They all have their appropriate uses, and in some passages produce a very grand effect; especially in serious pantomime, and such passages as demand the greatest exertion on the part of the band. We are, nevertheless, obliged to acknowledge, that in too many instances we have heard the too forcible notes of the trombone too powerfully and too indiscriminately uttered. Composers should consider this instrument as the *Ultima Thule* of those grave sounds, which seem to be travelling towards the lowest abyss of musical profundity. They should also recollect, that the performers on this potent tube rarely take it up, except to give the utmost emphasis to some strong marked passage: whence they conclude it necessary to out-Stentor Stentor, and absolutely "to split the ears of the groundlings." It does not appear possible, that the trombone can, like the trumpet, be played with a sweet soft tone, not louder than a flute; from all we have heard, it is, even when in the best hands, harsh, and almost unmusical.

We have various sizes of trumpets, some intended for concerts, and of course furnished with crooks; others are in use in our cavalry, made short and compact, and invariably pitched to one key; it is not unpleasant, though rather uncommon, to hear the trumpets of a cavalry corps sounding their several calls in parts; though the harmony is not varied, there is yet a something in it that reconciles us to its narrow limits, and indeed to the imperfectness of many reputed concords; few of which can be sounded correctly on trumpets. The sackbut, formerly in use among the Hebrews, and which is so often mentioned in scripture, was the basis of the modern trumpet; and, like it, could be lengthened at pleasure, so as to accord with other instruments. The clarion was a small trumpet. The Hebrews called their sacred trumpets keranim.

The next in this class is the *French Horn;* of which we have various sizes and descriptions. Those intended for concerts have, like the trumpet, various crooks, and a slide, whereby they may be brought to accord with the most scrupulous exactness. The horn always has its music written in the key of C, and acquires any other key at pleasure, by the addition of such crooks as may bring it to the proper pitch: the more crooks are affixed, the deeper will be the intonation. There is a very strong affinity between the horn and the trumpet, in regard to their capability of producing particular notes; what has already been said of the latter, in that respect, applies equally to the former. The finest notes of this instrument lie near the middle of the treble stave, or at furthest between G and C; though its low notes, when properly sounded, are very full and mellow. In skilful hands the horn is a most pleasing instrument; but when consigned to the learner, it, as well as the trumpet, is intolerable. Properly speaking, horns are tenor instruments, their tones being an octave below those of the trumpet; we have, however, tenor and-bass horns; though the former are rather uncommon: the latter are very powerful, and have a fine effect in military bands. The mouthpiece for this instrument is generally conical, the formation of the notes allowing more freedom, and requiring greater relaxation for all below the key-note, than the trumpet, which demands a peculiar constriction of the lips to blow with clearness, and in tune. Formerly the hunting horn was very large, so that it could be carried like a belt over one shoulder, and under the other; but of late years the practice has been to substitute a small crooked copper horn, which the huntsman fastens to a stirrup leather, or a sling: hence the old hunting music is nearly obsolete, for the small instrument now in use, and which is likewise borne by many of the guards to the mail-coaches, &c. is incapable of sounding many notes: the modern hunting calls are therefore monotonous.

The *Bugle* can scarcely be rated among musical instruments, but being found in military bands, we shall notice it. This instrument had its origin in the common shepherd's horn, *i. e.* that of an ox; it sounds only the notes of the common chord with any precision, though sometimes we hear attempts made to diversify its music. It is a very loud instrument, and answers admirably for its usual intentions; namely, assembling the detachments of a corps, communicating signals to rangers, &c. The bugle varies in size, some being a full yard in length, measured along their curve, while others are scarcely a foot in length. The ox-horn is an instrument of very ancient invention; it was originally known among the Hebrews by the name of shawm. The krum horn, now become obsolete, was a small kind of cornet, whose tones were imitated on the organ, by what is generally called the cremona stop. We shall perhaps be correct in tracing all the instruments of the trumpet and horn species to the buccina, of which the antiquity is so remote that its form and intonation have been lost to us. The ancient writers describe it as a crooked horn; we, however, venture to suggest, that the sea-conch was the true buccina, and that horns, properly so called, were used as substitutes where the conchs could not be obtained. The conchs sounded by the Hindoos throughout India, in their religious ceremonies, appear to have been in use from the first institution of that religion, which claims a date far more removed than the time of Adam. The conch is extremely sonorous, throwing its shrill tones often to the distance of a mile or more.

The *Serpent*, so called from its form, seems to be the link that connects the horn with the flute species; its mouthpiece is indeed very similar to that of the trumpet, but it is made of ivory. This is the deepest bass instrument of all that have finger holes, and which, consequently, have a chromatic compass. But the serpent has some of its lowest notes entirely dependent on the embouchure, or lip-play of the performer. This instrument descends two notes lower than the bassoon, and reaches up to F, on the clef line of the bass, with perfect facility and correctness of intonation. Some performers can, by great practice, advance several notes higher. The serpent is made of very thin wood, covered with buckram and leather, so as to become very firm; hence its tone is by no means smooth, the materials vibrating so very forcibly as to roughen the sounds, especially among the low notes. It has six finger-holes, each lined with ivory, ebony, &c. requiring a very firm hand to stop them well. This instrument forms an exact reinforcement to the basses of a military band, to which it is chiefly appropriated.

The *Bassoon*, or *Fagotto*, is the common bass for wind instruments; its compass extends from double B flat up to B flat in the middle of the treble stave. This great range is effected by the aid of a double elastic reed, which fits on to a brass serpentine crook, that gradually becoming thicker enters the top of the instrument. The sound is forced through the instrument in the first instance downwards, but re-ascends through a thicker parallel tube, on which are six holes for the middle fingering: the lower notes are made by a variety of keys and holes, which are managed by both the thumbs, and by the little finger of the right hand. The ample extent of its range gives the bassoon much importance, especially as it is perfectly chromatic throughout; the great similitude of its tone to a good bass voice renders it a most valuable accompaniment; the softness and the fine expression it is capable of producing occasion our best dramatic and lyric composers to avail themselves of its powers, and to allot to it many of the most pleasing passages in overtures, &c. The fingering of the bassoon is, however, extremely difficult; it requires much practice, and a kind of *penchant* for the instrument, to enable the performer to display its full scope, its delicate flute-like intonations, and to give a brilliancy to the wonderful execution of which it admits. It is a great pity that very few bassoons are perfectly in tune; those made by Barker, Wood, Millhouse, and Cramer, are generally preferred. When the common wooden nozle, or top, is exchanged for a copper trumpet, or bell-mouth, the sounds are much reinforced, and partake something of the intonation of a horn. There have been many varieties of this instrument, the principal of which are as follow: The bombardo, or dulcino, which was formerly used as a bass to the hautboy; the bassoonette, which is an octave higher than the bassoon, but exactly similar; the courtant, or short bassoon, which was made either for right or left handed performers; this appears to have been a very ancient instrument, and probably was the basis of that now in general use. The most curious of this tribe is the cervelet, now but little known, except by description; it was very short, scarcely indeed more than half a foot in length, and was blown with a double reed, the same as our bassoon, with which it could compare for depth of tone.

The next instrument of this class is the *Vox-humana*, so designated from the great resemblance of its tones to those of the human voice. This is a tenor to the hautboy, and is by many called the tenoroon; it was formerly much used in country churches, and proved a considerable check, keeping the choristers in the right road, and by its great powers concealed a multiplicity of errors among the rustic *marsyases*. Although the vox-humana is remarkably mellow and full-toned, it requires great practice and judgment to produce its notes in perfection. The compass of this instrument is very little more than two octaves; it has two keys, one of which makes the semi-tone above G in either octave, the other making the low F. It is blown with a double reed fixed on a small round conical staple or tube, which fits into the top of the instrument. There are six finger holes, though the third finger of the left hand has sometimes two, very small, instead of one of the ordinary size, for the purpose of making a semi-tone, by covering only one of them; the same as in the Italian hautboy. The bottom of the vox-humana is in form of a bell, and has usually two round holes, one on each side, for the purpose of lessening the vibration, and thus softening the tone. We consider the vox-humana, though exactly similar in every respect, excepting the depth of its notes and its greater bulk, to be far superior to the hautboy, and regret that so very pleasing an instrument should be laid aside, as it has been within the last twenty years. On the other hand, we consider the whole of the reed species of wind instruments to be extremely injurious to the constitution; few who practise them remain long in health, the bassoon and hautboy in particular.

The tones of the latter, *i. e.* the *Hautboy*, or *Oboe*, are by no means so smooth and agreeable as those of the instrument just described; the hautboy has obtained a place among theatrical and other numerous bands, more from the peculiarity of its intonations, and the studied cadences of those who give themselves up entirely to its practice, than from any real merit it possesses. Although we have often been highly gratified by the beautiful passages allotted to the hautboy, and which, being so very exquisitely delivered, commanded our admiration as much of the performer as of the music; yet we could never divest ourselves of the recollection of a bagpipe's nasal intonation; for, setting partiality and fashion aside, we must confess that the soft tones of the flute are better suited to the expression of smooth familiar music; and where more force, and deeper tones are required, we really prefer the clarinet to the hautboy.

We have already stated, that the formation, fingering, &c. of the hautboy, exactly resembles those points in the vox-humana, as does also in the reed, that of the former being smaller, proportioned to its size. Its scale reaches from the tenor C to D in alt; including every chromatic in tolerable perfection, except the low C sharp. Some performers reach to F natural, but we cannot say the sounds, though perfectly in tune, were satisfactory; on the contrary, they added to the nasal effect already noticed, a shrillness, if not a squeaking, which called to our remembrance the answer of Dr. Johnson to a friend who had performed what he termed a cruelly difficult solo on the violin, "Yes, sir, it was a cruel solo, and I wish it had been an impossible one!" The people of Asia have a kind of short hautboy, which has a large swell near its middle; they use a piece of double palm leaf for a reed. The intonations of this instrument, which are something similar to those of the hautboy, are peculiarly attractive to all the serpent tribe; which often quit their haunts on hearing it, and play round the performers; on this account it is invariably used by the snake-catchers.

The *Clarinet* appears to us, by far, the most noble instrument of this species, it being capable of such mellowness of intonation, such varied expression, and having such a compass: it performs the whole of the chromatic scale from E, below the bass-clef note, to F in alt; including rather more than three octaves, which exceeds any other wind instrument with which we are acquainted. The clarinet is, with great propriety, considered the principal in our military bands; in these its powerful and rich notes are duly displayed; we must, however, remark, that this instrument is not, generally speaking, calculated for chamber performance; for, with so few exceptions as to be unworthy notice, a certain sibilation is at times very audible, and there is much difficulty in rendering some transitions smooth, so as to avoid a certain kind of stoccato distinctness, not unlike an organ badly played: besides, the number of its keys, especially if they are patent, with metal plugs, occasions a rattling that distracts the attention, and greatly deteriorates the value of the instrument. In the open air, and at a little distance, when these defects cannot obtrude, we think the clarinet, either in a bold martial strain, or in a little *air baderiant*, or in a pathetic plaintive movement, stands pre-eminent above all the tribe of inflated instruments; for it admits of the finest swell, and of so much expression, that, in many points, it even claims a preference over the organ itself.

Clarinets have, in general, five keys, though some have six and eight holes, of which one, under the instrument, is stopped by the thumb of the left hand, which also commands a key called G sharp, or the calameau. The little finger of the right hand commands both a hole and a key. The G sharp key covers a very small brass tube, that projects through the wood, about a quarter of an inch, into the thickness of the bore in that part. When the key is uplifted by the thumb, the whole of the notes are raised a twelfth (*i.e.* twelve notes;) when it is shut, the tones become deep and rich, and are called calameau, probably in consequence of the brass tube above described, which originated in a small bit of reed having been inserted there. We are at the same time aware, that all wind instruments are but improvements upon the ancient calamus, or reed pipe, formerly used by shepherds and other rustics. The mouth-piece of the clarinet something resembles that of the common or English flute, but its groove would be open above for about an inch and a half, were it not covered by a flat single reed, the management of which is by no means very easy. When blown by a novice, the clarinet sounds extremely shrill and harsh, not unlike the most uncomfortable tones proceeding from a goose in distress. The bell of the clarinet is not pierced with lateral holes, as that of the hautboy is; it is spacious, and gives a prodigious resonance to the notes.

For the purpose of accommodating to those keys which are most easy on other instruments, various sizes of clarinets are made; chiefly C and B flat, but sometimes they are made in D; and for the purpose of playing the upper parts of melodies, the principal performers in military bands are provided with some in E flat: there being a minor third above the instruments in C, and a major fourth above those in B flat, raise the music greatly; of course the parts are transposed accordingly.

The *Flute* is one of our most common instruments, and affords more varieties than any of the foregoing. We shall first treat of the common flute, or flute-a-bec; so called from its embouchure bearing some little resemblance to a beak. It is, by many, supposed to be of English invention, but we cannot admit such to be the case, since it appears to resemble the old calamus, or shepherd's pipe, more than any other of this species. The sound is generated by blowing through a slit into the bore; the superfluous wind passing out at a vent made on the top, close to the upper end; there are seven finger holes above, and one for each thumb below; some have only one thumb-hole, others two small ones, like the G on a hautboy, for the purpose of making a semitone. All the flageolet tribe, which are of various sorts and sizes, belong to this species. The common flute is also made of various dimensions, thence assuming various designations of second, third, fourth, &c. according as it diminishes in size, and becomes shriller in tone. The common flute yields a very soft, agreeable sound, and is very appropriate to little artless airs; but having very little power, is by no means adapted to join in a band. The flageolet is, however, introduced, on many occasions, into dramatic orchestras, and finds a place in some bands; its very piercing notes may be at all times distinguished.

The *German Flute*, or *Traversa*, so called from its being placed cross-wise. When this mode of blowing the instrument was first introduced we cannot say, for the generality of medals, statues, &c. of very ancient date, exhibit performers on the avena, common pipe, such as our English flute above described. The auletes, or Grecian flute players, and the Roman tibicines, who performed on double flutes, one fingered by the right, the other by the left hand, thence called dextræ and sinistræ, all played on instruments a-bec, and not traversa. The recorder was of the same form; and the still more antiquated monauchos was made of a horn originally, (though afterwards of wood) consequently we are to suppose it also was blown a-bec. The instrument called the zuffolo, or, in French, the soufflet, is but a diminutive flageolet, used for teaching birds. We may, from these premises, safely conclude that the German flute is a very modern invention: its name points out the quarter whence it originated.

In lieu of a few simple notes, such as were afforded by the avena, or oaten-straw, and by the calamus, or reed, our flutes have attained to the compass of nearly three octaves, commencing with the tenor, C, and reaching up to double B flat in alt, including every chromatic, in various degrees of intonation. Flute-playing is now absolutely a science, and, properly speaking, demands some knowledge of the theory; for to accompany well requires an acquaintance with the intended effect of particular keys, and to form an accompaniment from an arpeggio, or other such passages as a flutist must often do at sight, includes a familiarity with the general rules of counterpoint. We have now flutes with no less than eight keys. From them the various notes are formed, aided by the six holes appropriated to the regular fingering of the instrument, as originally invented; *viz.* with only one key, appropriated to the little finger of the right hand. We have flutes with extra joints, patent slides, patent metallic plugs, &c.; yet, strange to say, it is absolutely a very rare thing to hear a flute in perfect tune. The fault, however, not unfrequently lies with the performer, who should possess an excellent ear: for, though the notes are supposed to be ready made, according to the directed fingerings, yet so much depends on his embouchure, and his manner of blowing, that there remains almost as much for him as for the violin player, towards producing truly correct intonations. The sweet mellow tone of the German flute adapts it admirably to those passages requiring tender expression; its swell renders it capable of yielding an efficient and a graceful holding note; while the warbling of its shake seems to rival the feathered songster. We regret often to hear these qualities most egregiously misapplied, and, indeed, neglected, to make way for a very uncharacteristic frittering of the notes, in hurried succession, and in a very absurd style: the promiscuous applause of a wondering audience is frequently bestowed on a performer, whose quibbles on this instrument should rather be discountenanced. What the flute can do should be reserved for solos on that instrument.

The several kinds of flutes are distinguished according to the number of keys, to their purposes, and to their sizes; they are generally called seconds, thirds, &c. as they recede from the standard, diminishing gradually, according to the above terms. The smallest flutes are called piccolo, which implies diminutive: this kind may be sometimes heard in military bands, in which it is often introduced with effect, but we have heard it too much employed by the composer.

The *Fife* is a well known instrument, almost exclusively allotted to military purposes. Its scale is rather less copious than that of the flute; and for want of keys, though of late years one has been added to some fifes, the chromatic progressions are extremely imperfect.

The *Pipe* is very little known, except as a shrill accompaniment to the tabor, and in pastoral dances. Some pipes have two, others three holes above, and one for the thumb below; all managed by the left hand, the right using the stick for the tabor, which is suspended from the wrist of the left hand.

The *Bagpipe* is of two sorts; *viz.* the Scots and the Irish: the former is filled by means of a wind-bag, carried under the arm, and worked like a pair of bellows, the other plays with a reed, like the hautboy. These two species have within these few years, been blended, under the designation of the union-pipes; both are fingered much the same as a flute, and have a drone, or open tube, through which the wind passes, causing a deep humming tone. The bagpipe, however ancient many assert it to be, nevertheless appears to be derived from the old Gallic musette (which it in every instance resembles); as the musette was from the ancient Hebrew sampunia. Happily all this genus are rapidly declining.

Having noticed the whole, if we err not, of the instruments in the second class, *i. e.* of inflation, we shall close their description with observing, that in the organ building line the names of Lincoln and England have long been pre-eminent; and that in the manufacture of flutes, Mr. Potter has been justly celebrated. On the whole, however, we have great reason to believe that the wind instruments made by Messrs. Wood, Goulding, and Co. of New Bond-street, will be found excellent of their kind: the great extent of their sales, in that branch, evinces the satisfaction they give, and which a very expensive establishment, of the best artificers, seems likely to uphold.

The class of collision seems to appertain exclusively to those instruments which are provided with strings, or wires, and are played upon by means of a piece of curved wood, subtending a quantity of horse hairs, regularly disposed in a flat and parallel manner: these we call bows; they are of various sizes, according to the instruments to which they respectively are applied; namely, the double bass, the violoncello, the tenor, the violin, and the kit.

The form of the *Double Bass* is well known; its tones are of a whole octave below those of the violoncello, and its scale is equally perfect. It sometimes has a part composed expressly for it, under the term violono; in which case it performs only the most accented parts of the bass, bordering, indeed, on the fundamental progressions: in most instances, we see it playing in unison with the violoncello. The double-bass certainly is very emphatic, and has a rich effect in such passages as require to be strongly marked.

The *Violoncello* is an instrument perfectly indispensable in all orchestras, and at regular musical meetings; its scale is extensive, being down to double C, and reaching as high as A, or B flat, in the middle of the treble stave. Its tones are very fine; and, in the hands of a solo performer, the violoncello displays a brilliancy far beyond what its appearance would lead us to expect.

The *Tenor*, *Alto*, *Taille*, or *Quiente*, is a large-sized violin, one octave above the violoncello, and, like it, has two catgut and two covered strings: this instrument sustains the medium parts between the treble and the bass, connecting the harmony, and filling that great interval, which would else be inevitably left void on many occasions. We think the tenor possesses a most mellow and expressive tone: when supporting a full passage, it proves a fine prop to the trebles; and when leading the melody, and sustained by the violoncello, affords, in general, a rich treat to musical amateurs. Its effect is best heard in Pleyel's Quartets, &c.

The *Violin* may be considered as the chief of this tribe: it will be unnecessary to describe its form, &c. the instrument being so universally known: its scale extends from G, above the base clef, up to double D, in alt; beyond which, though notes may be made, the tone becomes rather offensively shrill; and, generally speaking, borders on a kind of whistling scream. The pre-eminent expression, and the wonderful execution which may be effected with the violin, added to the great compass we have above stated, (it being full three octaves and a half) justly occasion this incomparable instrument to take the lead in concerts and orchestras; and, in general, in all musical meetings. It is to be lamented, however, that we cannot boast of so complete an intimacy with the construction of the violin, and of all its class, as Italy and some other parts of the Continent. We have some tolerable makers; but the names of Amati, Staduarius, &c. no sooner appear, than the names of inferior workmen seem to shrink from notice. It really is surprising, but strictly true, that immense quantities of violins, tenors, &c. &c. are regularly imported from the Continent, as a wholesale trade, and at so low a rate as five, six, or seven shillings each; from these our inferior performers are chiefly supplied. Hence it must be obvious that our artizans in this line suffer under a very injudicious toleration, which, in any other branch of business, would be speedily complained of, and the importation be restricted to the raw material. Possibly the legislature may, at some leisure moment, turn its attention to this subject.

The *Kit*, or pocket-violin, is a small instrument intended for the use of dancing-masters, &c. : it differs in no respect from the above description, except in the poorness of its tones, which are by no means pleasant; owing to the want of space for placing the fingers, it is extremely difficult to perform well on the kit.

We scarcely know with what to class the *Humstrum*, which consists of a large lath made into a bow, by means of a very thick piece of cat-gut, such as the string of a double bass : on this string a bladder is affixed. The humstrum is played with a bow, rubbed with rosin, the same as for the violin, &c. and the notes, which, however, are few in number, are made by shifting the fingers, or occasionally the bladder : we believe this instrument is used only among the vulgar, and that it is very nearly obsolete.

All the violin class have four strings, fastened at one end to a small piece of ebony, called the tail-piece; and, after passing over a raised bridge, made of seasoned beech-wood, (particularly the back of old instruments) and over a little ridge, called the nut, are fastened respectively to four pegs, made of very hard tough wood, by the turning of which they are put in tune: all the strings give fifths to their neighbours throughout: thus the first string is E, the second is A, the third is D, and the fourth, which is a covered one, is G. The tenors and basses have no E string; but a C one, added below the G. The notes are made by compressing, *i. e.* by what is called stopping, the strings on a rounded strip of ebony, called the finger-board, which proceeds from the nut, full four-fifths of the distance between that and the bridge: the latter being always placed on the belly, or sounding-board, exactly between the centres of two sound-holes, which are in the form of an S: the belly is supported by a small piece of rounded deal, called the sounding-post, without which the tones would be imperfect and harsh. The invention of sounding-boards appears to have been taken from the echeia, or vases, placed among the audium, and especially near the performers, in the ancient theatres, for the purpose of resonance. See Orchestra.

The whole of those instruments, which are retained in modern use, are occasionally to be found collected in an orchestra; but for a military band, such only can be adapted as are portable, and are not subject to lose, or to change their intonations, or to be injured in the open air, or whose casualties could not be immediately made good. Hence all stringed instruments are unfit for the latter purpose.

MUSICIAN, is defined by Dr. Busby, as one who understands the science of music, or who sings, or performs on some instrument, according to the rules of art. There are three kinds of musicians; the speculative musician, or musical author, properly so called, who contemplates and writes on the laws of sound and harmony; the practical theorist, or composer, who produces music written agreeably to those laws; and the performer, who with his voice or instrument, executes the music when written.

MUSK, a substance secreted in a kind of bag in the umbilical region of the moschus moschifer. It is of a brown red colour, feels unctuous, and has a bitter taste. Its smell is aromatic and intensely strong. It is partly soluble in water, which acquires its smell; and in alcohol, but that liquid does not retain the odour of the musk. Musk is dissolved by nitric and sulphuric acids, but the odour is by them destroyed. Fixed alkalies develope the odour of ammonia.

MUSKET, a fire-arm borne on the shoulder, and used in war. The length of a musket is fixed at three feet eight inches from the muzzle to the pan, and it carries a ball of sixteen to the pound.

In fortification, the length of the line of defence is limited by the ordinary distance of a musket shot, which is about 120 fathoms; and the length of almost all military architecture is regulated by this rule.

MUSKETOON, a kind of short thick musket, whose bore is the thirty-eighth part of its length; it carries five ounces of iron, or seven and a half of lead, with an equal quantity of powder. This is the shortest sort of blunderbusses.

MUSLIN, a fine thin sort of cotton-cloth, which bears a downy knap on its surface. There are several sorts of muslins brought from the East Indies, and more particularly from Bengal; such as doreas, betelles, mulmuls, tanjeebs, &c.

MUSSÆNDA, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Contortæ. Rubiaceæ, Jussieu. Essential character: corolla funnel form; stigmas two, thickish; berry oblong, inferior; seeds disposed in four rows. There are three species, natives of the East Indies, China, and Cochin China.

MUSSEL. See **Mytilus.**

MUSTER, in a military sense, a review of troops under arms, to see if they be complete and in good order; to take an account of their numbers, the condition they are in, viewing their arms and accoutrements, &c. At a muster every man must be properly clothed and accoutred, &c. and answer to his name.

Muster *roll*, a specific list of the officers and men in every regiment, troop, or company, which is delivered to the inspecting field officer, muster-master, regimental or district paymaster (as the case may be) whereby they are paid, and their condition is known. The names of the officers are inscribed according to rank, those of the men in alphabetical succession. Adjutants of regiments make out the muster rolls, and when the list is called over, every individual must answer to his name. Every muster roll must be signed by the colonel or commanding officer, the paymaster and adjutant of each regiment, troop, or company; it must likewise be sworn to by the muster-master or paymaster (as the case may be) before a justice of the peace, previous to its being transmitted to government.

MUTE, in case any person refuses to plead to an indictment for felony, &c. he is now, by stat. 12 Geo. III. c. 20, to be considered as pleading guilty, and to be punished as upon confession. Formerly a plea was extorted from him by a process, which was the *peine forte et dure*, and which has been justly considered as inhuman and disgusting. In a late trial, the case of Governor Picton, who was prosecuted for putting a young girl to torture, to extort evidence in the West Indies, this *peine forte et dure* has been called torture, but this is a gross perversion of language to justify cruelty and barbarity. The former ceased the moment the person put himself on his county, that is, on a jury for trial, by the formally pronouncing the words not guilty. The latter is continued and increased the more the sufferer asserts his innocence, and is instituted for the purpose of extorting by cruelty, a confession of guilt, whether true or false. Perish the wretch, who in thought even endures the revival of the most odious of all human crimes, the application of torture.

A prisoner, deaf and dumb from his birth, may be arraigned for a capital offence, if intelligence can be conveyed to him by signs or symbols.

Mute, in grammar, a letter, which yields no sound without the addition of a vowel. The simple consonants are ordinarily distinguished into mutes and liquids, or semi-vowels.

The mutes in the Greek alphabet are nine, three of which, *viz.* ϖ, κ, τ, are termed tenues: three, β, γ, δ, termed mediæ; and three, φ, χ, θ, termed aspirates. The mutes of the Latin alphabet are also nine, *viz.* B, C, D, G, I, K, P, Q, T.

MUTINY, in a military sense, to mutiny is to rise against authority. Any officer or soldier who shall presume to use traitorous or disrespectful words against the sacred person of his Majesty, or any of the Royal Family, is guilty of mutiny. Any officer or soldier who shall behave himself with contempt or disrespect towards the general, or other commander in chief of our forces, or shall speak words tending to their hurt or dishonour, is guilty of mutiny. Any officer or soldier who shall begin, excite, cause or join in any mutiny or sedition, in the troop, company, or regiment, to which he belongs, or in any other troop, or company, in our service, or on any party, post, detachment, or guard, on any pretence whatsoever, is guilty of mutiny. Any officer or soldier who, being present at any mutiny or sedition, does not use his utmost endeavours to suppress the same, or coming to the knowledge of any mutiny, or intended mutiny, does not, without delay, give information to his commanding officer, is guilty of mutiny. Any officer or soldier, who shall strike his superior officer, or draw, or offer to draw, or shall lift up any weapon, or offer any violence against him, being in the execution of his office, on any pretence whatsoever, or shall disobey any lawful command of his superior officer, is guilty of mutiny. See the Articles of War.

MUTISIA, in botany, so named in memory of Joseph Cælestine Mutis, an American botanist, a genus of the Syngenesia Polygamia Superflua class and order. Natural order of Discoideæ. Corymbiferæ, Jussieu. Essential character: calyx cylindric, imbricate; corollets of the ray oval oblong; of the disk trifid; down feathered; receptacle naked. There is but one species, *viz.* M. clematis, found in New Granada.

MUTULE, in architecture, are blocks projecting from the soffit of the corona, immediately over the triglyphs on the frize; and very frequently over the metope or space between the triglyphs, as may be seen in many examples of Grecian architecture.

The mutules have three rows of guttæ or drops, depending from their soffits, similar to those at the base of the triglyph. They belong exclusively to the Doric order.

MYA, in natural history, a genus of insects of the Vermes Testacea class and order. Animal ascidia; shell bivalve, generally gaping at one end; hinge with broad thick strong teeth, seldom more than one, and not inserted into the opposite valve. The animals of this genus perforate into the sand and clay at the bottom of the sea, burying themselves and their shells wholly or in part. There are about twenty-five species. M. declivis has a brittle, semi-transparent shell, sloping downwards near the open end; the hinge slightly prominent. It is found about the Hebrides, and the animal is in great esteem among the inhabitants. M. margaritifera inhabits most parts of the arctic circle, and is generally found in mountainous rivers, and about cataracts. It is about five inches long, and half as many broad. The shell is often corroded with worms; it is noted for producing large quantities of mother of pearl and pearl; the latter is said to be a disease of the fish analogous to the stone in the human body. The river Conway, in Wales, was formerly famous for producing pearl of great size and value. M. dubia, shell with an oval and large hiatus, opposite the hinge, and the rudiment of a tooth within one valve. It is found near Weymouth; the shell is brittle, about the length of a horse-bean, and shaped like a pistachia-nut.

MYAGRUM, in botany, *gold of pleasure*, a genus of the Tetradynamia Siliculosa class and order. Natural order of Siliquosæ, or Cruciformes. Cruciferæ, Jussieu. Essential character: silicle terminated by a conical style, with a cell commonly one-seeded. There are ten species, of which M. perenne, perennial gold of pleasure. Mr. Miller describes this as an annual plant, notwithstanding he gives it Linnæus's epithet of perenne; the lower leaves are large, jagged, and hairy; the stalks branching out from the bottom; leaves about four inches long, and two broad; the stalks terminated by very long loose spikes of yellow flowers, succeeded by short pods with two joints, each including one roundish seed. Linnæus remarks that the lower joint of the silicle is strict and abortive; the upper globular, striated, one-seeded. Native of Germany.

MYCTERIA, the *jabiru*, in natural history, a genus of birds of the order Grallæ. Generic character: bill long and large, both mandibles bending upwards, the upper triangular; nostrils small and linear, and no tongue; feet four-toed and cleft. M. Americana, or the American jabiru, is nearly six feet in length, and makes a nearer approach than any other bird to the size of the ostrich. It abounds in the level districts of Cayenne, and other parts of South America, feeds upon fish, of which it devours immense quantities, and builds in vast trees, laying only two eggs. It is extremely wild; when young is used for food, but when old is hard and rancid. Many have supposed this to be the American ostrich of various authors, and Latham expresses himself rather confidently as of the same opinion. A specimen is in Peale's Museum.

MYGINDA, in botany, so named in honour of the most noble Francis à Mygind, Aulic Counsellor, well skilled in botany, and protector of the botanic garden at Vienna, a genus of the Tetrandria Tetragynia class and order. Natural order of Rhamni, Jussieu. Essential character: calyx four-parted: petals four; drupe globular. There are three species, natives of the West Indies.

MYOPES. Those, who by a natural defect have the cornea and crystalline humour too convex, are called myopes. This figure, which increases the quantity of refraction, tends to render the rays of such pencils as are formed in the eye more convergent, so that the point where these same rays meet is on this side of the retina. Myopes see distinctly those objects only which are near, which send towards the eye rays more divergent, and thereby less disposed to converge, through the effect of refraction in the crystalline and other humours. This imperfection, being the reverse of that which affects the eye of presbytæ, is remedied by the use of a glass slightly concave; which, increasing the divergence of the rays received by the eye, prolongs the pencils that are formed in the organ, and causes their summits to fall more exactly on the retina. Myopes seem to have a fondness for minute objects: in general they write a very fine hand, and read in preference works that are printed in a small type, because, by choosing dimensions suited to the narrow scope of their sight, they continue to embrace a greater number of objects at once. They have the habit also of closing, in a certain degree, the eyelids, when they wish to see objects distinctly that are otherwise distant from them. Two advantages have been ascribed to this natural motion. On the one hand, by contracting the lid, access is given to a smaller portion of light. Now those who are myopes see objects that are situated at a distance indistinctly, merely because the cones that are formed in the eye, as we have observed in the preceding paragraph, have their summit on this side the retina; so that the prolongations of the rays, of which these cones are the assemblage, give rise to new cones, whose base meeting the bottom of the eye, depicts a small circle there, instead of a simple point. Accordingly, when the number of rays introduced into the eye is diminished, that small circle is contracted, and the vision becomes less confused. On the other hand, the eye-lids, by closing, exert a pressure on the organ, that diminishes its convexity, and in part restores it to the form most favourable to clearness of vision.

MYOPORUM, in botany, a genus of the Didynamia Angiospermia class and order. Natural order of Personatæ. Essential character: calyx five-parted; corolla bell-shaped, with a spreading almost equal five-parted border; berry one or two-seeded; seeds two-celled. There are four species; these plants are natives of the islands of the South Sea.

MYOSOTIS, in botany, *scorpion-grass*, a genus of the Pentandria Monogynia class and order. Natural order of Asperifoliæ. Boragineæ, Jussieu. Essential character: corolla salver-shaped, five-cleft, emarginate; the opening closed with arches. There are seven species, of which M. scorpioides, mouse-ear scorpion grass, has an annual fibrous root; stems several, procumbent, erect; leaves alternate, entire, bent back a little at the edge; the lower leaves are elliptic or oblong, the middle and upper ones are lanceolate, from an inch and half to two inches in length; flowers in racemes, when young, bending in at the top, whence the names of scorpioides, scorpiurus, and scorpion-grass, from the similitude to a scorpion's tail; as the flowering advances, lengthening out very considerably: they are alternate, in a double row, all growing one way, each on its proper pedicle; calyx villose, deeply five-cleft, closing at top as the seeds ripen; corolla red before it opens, afterwards of a fine blue, with a yellow eye, not more than a tenth of an inch in diameter.

MYOSURUS, in botany, *mouse-tail*, a genus of the Pentandria Polygynia class and order. Natural order of Multisiliquæ. Ranunculaceæ, Jussieu. Essential character: calyx five-leaved, growing together at the base; petals five, having a melliferous pore at the claw: seeds numerous. There is but one species, *viz.* M. minimus, mouse-tail: this plant is very nearly allied to ranunculus, in which genus it was ranged by Tournefort; the flowers are extremely small, and are succeeded by long, slender spikes of seeds, resembling the tail of a mouse, whence the name; it grows wild in most parts of Europe. This plant affords a rare instance of a very great disproportion of males to females in the same flower, and yet the latter are generally all prolific; the seeds are justly described by Linnæus as naked, for the part which Jussieu calls a capsule, is nothing more than a thickened inseparable coat, as in ranunculus.

MYOXUS, the *dormouse*, in natural history, a genus of Mammalia of the order Glires. Generic character: two fore-teeth, the upper wedge formed, the lower compressed; four grinders in each jaw; long whiskers; tail cylindric, bristly, and thicker towards the end; legs of equal length; fore-feet with four toes. These animals feed only on vegetables, and burrow in the ground, in which they continue during the winter in a torpid state. They are nocturnal, sleeping in their habitations the greater part of the day; they carry food to their mouths with their fore-paws, sitting erect, and advance by leaps of several feet at a time, instead of walking. There are four species, neither of which inhabits America: M. glis, or the fat dormouse, is found in Germany and Russia, and has much of the manners of a squirrel, haunting trees, and feeding on fruits and nuts, which it stores, like that animal, for its winter consumption. It was highly valued by the Romans as an article of food. It is six inches long to the tail, which is about four. It is not easily tamed.

M. muscardinus, or the common dormouse, is nearly of the size of a mouse, and inhabits thick hedges, making its nest in the hollow of some tree. It is far from lively, and is incapable of bounding like the squirrel. Like that animal, however, it forms its hoard for the winter, during which it is for the greater part abstinent and torpid. It occasionally is roused by the intervention of temperate days, recurs to its stock, and then returns to its slumbers, till spring recovers it to daily exertion. It is very rarely seen in this country, but is supposed to be in fact by no means uncommon. For the garden dormouse, and the wood dormouse, see Mammalia, Plate XVII. fig. 1 and 2.

MYRICA, in botany, *candleberry myrtle*, a genus of the Dioecia Tetrandria class and order. Natural order of Amentaceæ, Jussieu. Essential character: ament with a crescent-shaped scale; corolla none; female, styles two; berry one-seeded. There are nine species, of which M. gale, sweet-gale, sweet-willow, or candleberry myrtle, rises with many shrubby stalks, from two to four feet in height, dividing into several slender branches: the buds are composed of nine leafy, shining scales; leaves alternate, an inch and a half in length; they have a bitter taste, and an agreeable odour, like those of myrtle. The flowers appear before the leaves, at the ends of the branches; as soon as the fructification is completed, the end of the branch dies, the leaf-buds, which are on the sides, shoot out, and the stems become compound; the fruit is a coriaceous berry; the male and female aments are sometimes on distinct plants, and sometimes on the same individual. The northern nations formerly used this plant instead of hops, and it is still in use for that purpose in some of the western isles; unless it is boiled a long time, it is reported to occasion the head-ach. The catkins, or cones, boiled in water, throw up a scum resembling bees' wax, and which, gathered in sufficient quantities, would make candles. From M. cerifera, American candleberry myrtle, candles are prepared in America; it is also used in tanning calf skins; gathered in autumn, it will die wool yellow, for which purpose it is used both in Sweden and in Wales; the Welsh lay branches of it upon and under their beds, to keep off fleas and moths. In most of the Hebrides, and in the Highlands of Scotland, an infusion of the leaves is frequently given to children to destroy worms. When it grows within reach of a port, the sailors make besoms of it for sweeping their ships. Native of the northern parts of Europe and North America.

MYRIOPHYLLUM, in botany, a genus of the Monoecia Polyandria class and order. Natural order of Inundatæ. Naiades, Jussieu. Essential character: calyx four-leaved; corolla none: male, stamina eight; female, pistils four; style none; seeds four, naked. There are two species, *viz.* M. spicatum, spiked water milfoil, and M. verticillatum, whorled water milfoil. These are perennial herbs, inhabitants of the water, leaves in whorls, pinnate linear; flowers axillary, sessile, solitary, in the upper whorls male, in the lower female: in the second species they are frequently hermaphrodite.

MYRISTICA, in botany, *nutmeg-tree*, a genus of the Dioecia Syngenesia class and order. Natural order of Lauri, Jussieu. Essential character: calyx trifid; corolla none: male, filament columnar; anthers terminating, united: female, capsule superior, drupaceous, two-valved; nut involved in an aril, called the mace. There are three species, of which M. aromatica, aromatic or true nutmeg-tree, grows to a considerable size in the East Indies, with erect branches, and a smooth ash-coloured bark; the inner bark is red; leaves petioled, alternate, quite entire, shining, paler underneath, nerved peduncles axillary, two or three flowered, solitary; only one flower arrives at maturity; calyx fleshy, smooth; segments spreading shorter than the tube; filament solid, the length of the calyx; anthers eight, ten or twelve, growing longitudinally round the upper half of the filament; calyx in the female smaller; covering of the fruit or mace subdivided irregularly like a net, fulvous. The leaves are aromatic; and if the trunk or branches be wounded, they will yield a glutinous red liquor.

MYRMECIA, in botany, a genus of the Tetrandria Monogynia class and order. Natural order of Gentianæ, Jussieu. Essential character: calyx tubular; five-toothed: corolla one-petalled, with an inflated mouth and five-cleft border; germ with five glands at the base; stigma bilamellate; capsule two-celled, two-valved, many seeded. There is but one species, *viz.* M. tachia, which is a shrub five or six feet in height; thick at the base, gradually diminishing as it ascends, throwing out a few long, rough, four cornered branches, which are opposite and tubular; at each knot of these branches grow two opposite leaves, disposed crossways; from the bosom of one of these leaves proceeds a sessile flower, of a yellow colour; and it generally happens that, at the bosoms of those leaves which do not produce flowers, a tear of yellow resin makes its appearance. The hollow trunk and branches of this shrub are commonly the retreat of a great many ants, for which reason it is called by the natives of Guiana tachi, which is said to signify an ant's nest.

MYRMECOPHAGA, the *ant-eater*, in natural history, a genus of Mammalia, of the order Bruta. Generic character: no teeth; tongue extensile and cylindric; mouth elongated into a form somewhat tubular; body covered with hair. Though these animals are stated above to have no teeth, dissection shows that they have certain bony substances, not very different from them, fixed firmly at the lower end of their jaws. They subsist on insects, and particularly that genus of them from which they are designated. Thrusting their tongue into a nest of ants, the glutinous substance which exudes from it serves to attach to it inextricably numbers of these insects, and when the animal perceives, by the exquisite feeling of the papillæ, that he has secured a sufficient number, he withdraws his tongue by an instantaneous movement, and swallows his victims. There are seven species. The following are principally deserving of attention.

M. jubata, or the great ant-eater, is an animal of a very inelegant and rough appearance, and more than seven feet in length. It is a native of South America, slow in its movements, and heavy in its manners, sleeping during almost the whole day; the night it passes principally in search of food. With its fore claws it can destroy by pressure and laceration animals apparently much stronger than itself. In a state of confinement it has devoured four pounds of animal food in a day. A specimen is in Peale's Museum.

M. tetradactyla, or the middle ant-eater, is far inferior in size, being little more than two feet in its whole length. It is a native of the same regions, and is similar in its habits. It possesses, however, a prehensile power with its tail, and in climbing trees, and moving from branch to branch, is much assisted by this circumstance.

M. didactyla, or the little ant-eater, is about as large as a squirrel, covered with a soft and curly fur of yellow brown, and possesses considerable elegance. Its tail is prehensible; it resides in trees, and subsists, like the former species, principally on insects, and particularly ants. It is a native of Guiana. Animals of a similar description are found both in Africa and the Indian islands. In the former, they are stated to attain the weight of a hundred pounds, and to have such a tenaciousness of gripe, that the efforts of the strongest man cannot unfix their claws when fully stuck in the ground.

M. aculeata, or the aculeated ant-eater, is a native of New Holland, and appears to connect the ant-eater genus with the porcupine. It has the spines of the latter, and the mouth, tongue, and habits of the former. It is generally found in the middle of an ant's nest, and will burrow with extreme celerity. It will even tear up a pavement of some firmness. It is little more than a foot long, and is preserved in Peale's Museum, but the specimen is somewhat mutilated. For a representation of the ant-eater, see Mammalia, Plate XVII. fig. 3.

MYRMELEON, in natural history, *lion-ant*, a genus of insects of the order Neuroptera. Mouth with a horny, acute mandible and jaw; feelers six; antennæ thicker at the tip; wings deflected; tail of the male armed with a forceps, composed of two straight filaments. There are sixteen species of this genus enumerated by Gmelin, which are divided into two sections, *viz.* A. Hind-feelers much longer; jaw one-toothed; lip membranaceous, square, truncate, emarginate. B. Feelers nearly equal; jaw ciliate; lip horny, rounded, entire. The animals of this family prey with the most savage ferocity on ants and lesser insects, and for the purpose of ensnaring them, sinks itself into the sand, and forms a kind of funnel or pit, in which it lies buried, the head immediately beneath the apex of the inverted cone. Into this hollow such insects as fall, not being able to crawl up the sides of loose sand, are seized and devoured by the lion-ant. But if the sides of the pit do not give way, or the unlucky insect appears to be able to make its escape, its merciless enemy, by throwing with its head repeated showers of sand, forces it down till it comes within its reach. The larva is six-footed, with exserted, toothed jaws; pupa inclosed in a ball composed of sand or earth, agglutinated and connected by very fine silk, which it draws from a tubular process at the extremity of the body: with this silk it also lines the internal surface of the ball, which, if opened, appears coated by a fine pearl-coloured silken tissue. It continues in the state of chrysalis about four weeks, and then gives birth to the complete insect. M. formicaleo, in its complete, or fly-state, bears a great resemblance to a small dragon-fly, from which it may be distinguished by its antennæ. It is a native of Europe. See Plate III. Entomology, fig. 5.

MYRODENDRUM, in botany, a genus of the Polyandria Monogynia class and order. Essential character: corolla five-petalled, spreading, much larger than the five-toothed calyx; stigma capitate, five-lobed; pericarpium five-celled, with one seed in each cell. There is but one species, *viz.* M. balsamiferum: this is a tree from fifty to sixty feet in height, and two in diameter; it throws out from the top several large branches, which divide into branchlets, beset with alternate, smooth, green, long leaves, terminating in a point; these leaves are largest at their base, where they partly embrace the branchlets: the flowers are borne in heads or clusters, from the leaves at the extremities of the branchlets, of a white colour. The bark of this tree affords a red balsamic fluid, resembling styrax in scent; this liquor, after it has exuded from the bark, becomes hard, brittle, and transparent, and, when burnt, affords a very agreeable odour. The Negroes use the bark for the purpose of slips, to make flambeaux, and the natives for building their houses. It grows naturally in the forests of Guiana.

MYRODIA, in botany, a genus of the Monadelphia Polyandria class and order. Natural order of Columniferæ. Malvaceæ, Jussieu. Essential character: calyx single, one-leafed; corolla five-petalled; pistil one; column of anthers undivided; drupe dry, inclosing two nuts. There are two species, *viz.* M. turbinata, and M. longiflora; the former is a native of the West Indies, and the latter of Guiana, growing on the banks of rivers.

MYROSMA, in botany, a genus of the Monandria Monogynia class and order. Natural order of Scitamineæ. Cannæ, Jussieu. Essential character: calyx double, outer three-leaved, inner three-parted; corolla five-parted, irregular; capsule three-cornered, three-celled, many-seeded. There is but one species, *viz.* M. cannæformis, a native of Surinam.

MYROXYLUM, in botany, *sweet-wood*, a genus of the Decandria Monogynia class and order. Natural order of Lomentaceæ. Leguminosæ, Jussieu. Essential character: calyx bell-shaped; petals five, the uppermost larger; germ longer than the corolla; legume one-seeded. There is but one species, *viz.* M. peruiferum; this is a very beautiful tree, with a smooth, thick bark, which is resinous; leaves alternate, leaflets in two pairs, mostly opposite, they are entire, veined, and very smooth: racemes axillary, erect, pointing one way, peduncle roundish, pubescent, flowers scattered; pedicles erect; calyx hoary green, on the outside of the orifice surrounded by the petals and anthers, which are white, within containing the green legume, having a singular appearance; the substance of the leaves is full of linear dots; they are transparent and resinous. The balsam of Peru is the produce of this tree; it is a native of the hottest provinces of South America.

MYRSINE, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Bicornes. Sapotæ, Jussieu. Essential character: corolla half five-cleft, converging; germ filling the corolla; berry one-seeded, with a five-celled nucleus. There are two species, *viz.* M. Africana, African myrsine, and M. retusa, round-leaved myrsine, or tamaja.

MYRTUS, in botany, *myrtle*, a genus of the Icosandria Monogynia class and order. Natural order of Hesperideæ. Myrti, Jussieu. Essential character: calyx five-cleft, superior; petals five; berry two or three-celled; seeds several, gibbous. There are thirty-six species, and many varieties. This genus is composed of small trees and shrubs: flowers in some solitary, with two scales at the base; in others forming opposite corymbs or panicles, axillary or terminating. The M. communis, common myrtle, is well known, and admired as an elegant evergreen shrub: it is a native of Asia, Africa, and the southern parts of Europe; it was a great favourite amongst the ancients, for its elegance, and its evergreen sweet leaves; it was sacred to Venus, either on this account, or because it flourishes most in the neighbourhood of the sea. Myrtle wreaths adorned the brows of bloodless victors, and were the symbol of authority for magistrates at Athens; both branches and berries were put into wine, and the latter were used in the cookery of the ancients: the myrtle was also one of their medicinal plants; it is an astringent, but is now discarded from modern practice.

MYTHOLOGY, the history of the fabulous gods and heroes of antiquity, with the explanations of the mysteries or allegories couched therein. Lord Bacon thinks, that a great deal of concealed instruction and allegory was originally intended in most part of the ancient mythology: he observes, that some fables discover a great and evident similitude, relation, and connexion, with the thing they signify, as well in the structure of the fable, as in the meaning of the names, whereby the persons or actors are characterized.

The same writer thinks it may pass for a further indication of a concealed and secret meaning, that some of these fables are so absurd and idle in their narration, as to show an allegory even afar off: but the argument of most weight upon this subject he takes to be this, that many of these fables appear by no means to have been invented by the persons who relate them: he looks on them, not as the product of the age, nor invention of the poets, but as sacred relics, as he terms them, gentle whispers, and the breath of better times, that from the tradition of more ancient nations came at length into the flutes and trumpets of the Greeks. He concludes, that the knowledge of the early ages was either great or happy: great, if they by design made this use of trope and figure; or happy, if, whilst they had other views, they afforded matter and occasion to such noble contemplations.

MYTILLUS, in natural history, the *mussel*, a genus of insects of the Vermes Testacea class and order. Animal allied to an ascida; shell bivalve, rough, generally affixed by a byssus, or beard of silken filaments; hinge mostly without teeth, with generally a subulate, excavated, longitudinal line. There are between fifty and sixty species, divided into sections, *viz.* A. parasitical, affixed as it were by claws; B. flat, or compressed into a flattened form, and slightly eared; C. ventricose, or convex. In the second division is M. margaritiferus, which inhabits the American and Indian seas; about eight inches long, and something broader; the inside is beautifully polished, and produces true mother-of-pearl, and frequently the most valuable pearls; the outside sometimes sea-green, or chesnut, or bloom-colour, with whitish rays; when the outer coat is removed, it has the same perlaceous lustre as the inside; the younger shells have ears as long as the shell, and resemble scallops. M. edulis inhabits European and Indian seas, found in large beds, adhering to other bodies by means of a long silky beard: the inhabitant affords a rich food, but is often noxious to the constitution.

N.

N, Or *n*, the thirteenth letter, and tenth consonant of our alphabet: it is a liquid, the sound of which is formed by forcing the voice strongly through the mouth and nostrils; being at the same time intercepted by applying the tip of the tongue to the fore-part of the palate, with the lips open. It suffers no consonant immediately after it in the beginning of words and syllables; nor any before it, except *g*, *k*, and *s*; as in *gnaw*, *know*, *snow*, &c.: as a numeral, N stands for 900; and with a dash over it, thus $\overline{N}$, for 900,000; N, or N^{o}, stands for numero, *i. e.* in number; and N. B. for nota bene, note well, or observe well.

NABOB, a corruption from nawaub, the plural of naib. The title means deputed, but it is often assumed in India without a right to do it. As the real signification and import of this word are not generally known, we shall extract a passage out of Mr. Orme's "History of the Carnatic," that will place them in the clearest point of view: "Most of the countries which have been conquered by the Great Mogul in the peninsula of India, are comprised under one viceroyalty, called from its situation, Decan, or South. From the word Soubah, signifying a province, the viceroy of this vast territory is called soubadar, and by Europeans, improperly, soubah. Of the countries under his jurisdiction, some are entirely subjected to the throne of Delhi, and governed by Mahomedans, whom Europeans improperly call Moors; whilst others remain under the government of their original Indian princes, or rajahs, and are suffered to follow their ancient modes, on condition of paying tribute to the Great Mogul. The Moorish governors depending on the soubah assume, when treating with their inferiors, the title of nabob, which signifies deputy; but this in the registers of the throne (of Delhi) is synonymous to Soubadar, and the greatest part of those who style themselves nabobs are ranked at Delhi under the title of phousdar, which is much inferior to that which they assume. The Europeans established in the territories of the pseudo-nabobs, (if we may be allowed the expression) following the example of the natives with whom they have most intercourse, have agreed in giving them the title they so much affect.

"A nabob ought to hold his commission from Delhi, and if, at his death, a successor has not been previously appointed by the Great Mogul, the soubah has the right of naming a person to administer the nabobship until the will of the sovereign is known; but a nabob thus appointed by a soubah is not deemed authentically established until he is confirmed from Delhi. The soubah receives from the several nabobs the annual revenues of the crown, and remits them to the treasury of the empire. The nabobs are obliged to accompany him in all military expeditions within the extent of his viceroyalty, but not in any without that extent. These regulations were intended to place them in such a state of dependence on the soubah as shall render them subservient to the interest of the empire, and at the same time leave them in a state of independence, which would render it difficult for the soubah to make use of their assistance to brave the throne. Nabobs, however, have kept possession of their governments in opposition both to the soubah and the throne; and what is more extraordinary, in the offices of a despotic state, both soubahs and nabobs have named their successors, who have often succeeded, with as little opposition as if they had been the heirs apparent of an hereditary dominion."

NABONASSAR, or *Æra of Nabonassar*, a method of computing time from the commencement of Nabonassar's reign. The epocha of Nabonassar is of the greater importance, as Ptolemy and other astronomers account their years from it.

NADIR, in astronomy, that point of the heavens which is diametrically opposite to the zenith, or point directly over our heads. The zenith and nadir are the two poles of the horizon.

NAJAS, in botany, a genus of the Dioecia Monandria class and order. Natural order of Inundatæ. Naiades, Jussieu. Essential character: male, calyx cylindric, bifid; corolla, four-cleft; filament none: female, calyx none; corolla none; pistil one; capsule ovate; one-celled. There is but one species, *viz.* N. Marina, which, according to Jussieu, has three whorled sheathing leaves, the flowers axillary, sessile; the filament in the male flowers long, with a four-valved anther, which is the four-cleft corolla of Linnæus; in the female flowers two stigmas, and one nut, or four seeds. Native of the sea coast of Europe; in the canal between Pisa and Leghorn; and in the Rhine, near Basle.

NAIL. See ANATOMY.

The nails have been chemically examined, and are found to be composed chiefly of a membranous substance, which possesses the properties of coagulated albumen. They contain also a little phosphate of lime. Water softens, but does not dissolve them. They are readily dissolved and decomposed by concentrated acids and alkalies. It is pretty certain that they are composed of the same substances as HORN, which see. Under the head of nails must be comprehended the talons and claws of the inferior animals, and likewise their hoofs, which differ in no respect from horn.

NAILS, in building, &c. small spikes of iron, brass, &c. which, being driven into wood, serve to bind several pieces together, or to fasten something upon them. The several sorts of nails are very numerous: as 1. Back and bottom nails; which are made with flat shanks, to hold fast and not open the wood. 2. Clamp nails, for fastening the clamps in buildings, &c. 3. Clasp-nails, whose heads clasping and sticking into the wood, render the work smooth, so as to admit a plane over it. 4. Clench-nails, used by boat and barge builders, and proper for any boarded buildings that are to be taken down, because they will drive without splitting the wood, and draw without breaking; of these there are many sorts. 5. Clout-nails, used for nailing on clouts to axle-trees. 6. Deck-nails, for fastening of decks in ships, doubling of shipping, and floors laid with planks. 7. Dog-nails, for fastening hinges on doors, &c. 8. Flat-points, much used in shipping, and are proper where there is occasion to draw and hold fast, and no conveniency of clenching. 9. Johent-nails, for nailing thin plates of iron to wood, as small hinges on cupboard doors, &c. 10. Lead-nails, for nailing lead, leather, and canvass, to hard wood. 11. Port-nails, for nailing hinges to the ports of ships. 12. Pound-nails, which are four-square, and are much used in Essex, Norfolk, and Suffolk, and scarcely any where else, except for pailing. 13. Ribbing-nails, principally used in ship-building, for fastening the ribs of ships in their places. 14. Rose-nails, which are drawn four-square in the shank, and commonly in a round tool, as all common two-penny nails are; in some countries all the larger sorts of nails are made of this shape. 15. Rother-nails, which have a full head, and are chiefly used in fastening rother-irons to ships. 16. Round head nails, for fastening on hinges, or for any other use, where a neat head is required; these are of several sorts. 17. Scupper-nails, which have a broad head, and are used for fastening leather and canvass to wood. 18. Sharp-nails, these have sharp points and flat shanks, and are much used, especially in the West Indies, for nailing soft wood. 19. Sheathing-nails, for fastening sheathing-boards to ships. 20. Square-nails, which are used for hard wood, and nailing up wall-fruit. 21. Tacks, the smallest of which serve to fasten paper to wood; the middling for wool-cards, &c. and the larger for upholsterers and pumps. Nails are said to be toughened, when too brittle, by heating them in a fire-shovel, and putting some tallow or grease among them.

NAIS, in natural history, a genus of the Vermes Mollusca class and order. Body creeping, long, linear, pellucid, depressed; peduncles, or feet, with small bristles on each side. There are ten species; N. digilata has single lateral bristles; tail laciniate. It is found in stagnant waters, or the sandy sediment of rivers, with its head attached to the stalk of aquatic plants. It is not half an inch long.

NAISSANT, in heraldry, is applied to any animal issuing out of the midst of some ordinary, and showing only his head, shoulders, fore-feet, and legs, with the tip of his tail, the rest of his body being hid in the shield, or some charge upon it; in which it differs from issuant, which denotes a living creature arising out of the bottom of any ordinary or charge.

NAMA, in botany, a genus of the Pentandria Digynia class and order. Natural order of Succulentæ. Convolvuli, Jussieu. Essential character: calyx five-leaved; corolla five-parted; capsule one-celled, two-valved. There is but one species, *viz.* N. Jamaicensis, an annual little plant, spreading much about the root; it is seldom more than five or six inches in length, with the stalk and branches margined.

NAME, denotes a word whereby men have agreed to express some idea; or which serves to signify a thing or subject spoken of. This the grammarians usually call a noun, though their noun is not of quite so great an extent as our name. See GRAMMAR.

NANDINA, in botany, a genus of the Hexandria Monogynia class and order. Essential character: calyx many-leaved, imbricate; corolla six petalled. There is but one species, *viz.* N. Domestica, a native of Japan.

NAPÆA, in botany, a genus of the Dioecia Monadelphia class and order. Natural order of Columniferæ. Malvaceæ, Jussieu. Essential character: calyx five-cleft; petals five: male, stamina monadelphous, very many, fertile; styles several, barren: female, stamina monadelphous, very many, barren; styles several, longer than the stamens; capsule orbicular, depressed, ten-celled; seeds solitary. There are two species, *viz.* N. lævis, smooth napæa, and N. scabra, rough napæa. Both these plants grow naturally in Virginia and many parts of North America; from their bark a kind of hemp may be procured, such as many of the malvaceous tribe afford.

NAPTHA, in chemistry, one of the bitumens, which has been used much lately in the experiments on the newly discovered metals of POTASSIUM and SODIUM, which see. Naptha is of a light colour, more or less transparent, perfectly thin and liquid, and so light as to float on water; it is odoriferous, volatile, and inflammable. See BITUMEN, PETROLEUM, &c.

NARCISSUS, in botany, a genus of the Hexandria Monogynia class and order. Natural order of Spathaceæ. Narcissi, Jussieu. Essential character: petals six, equal; nectary funnel-form, one-leafed; stamina without the nectary. There are fifteen species, of which we shall notice the N. tazetta, polyanthus, narcissus. It is a native of Spain and Portugal, the South of France, Italy and Japan; it has a large roundish bulb, from which proceed three or four narrow leaves; the scape, or flower-stalk, is upright, angular, concave, from twelve to eighteen inches in height; flowers very fragrant, clustered from seven to ten coming out of one spathe, of a white or yellow colour.

There is a greater variety of the polyanthus narcissus than of all the other species, for the flowers being very ornamental, and appearing early in the spring, the florists in Holland, Flanders, and France, have taken great pains in cultivating and improving them.

NARCOTIC *principle*. See OPIUM.

NARCOTICS, in medicine, soporiferous medicines, which excite a stupefaction.

NARDUS, in botany, *mat-grass*, a genus of the Triandria Monogynia class and order. Natural order of Gramina, Gramineæ, or Grasses. Essential character: calyx none; corolla two-valved. There are four species.

NARRATION, in oratory and history, a recital or rehearsal of a fact as it happened, or when it is supposed to have happened. Narration is of two kinds, either simple or historical, as where the auditor or reader is supposed to hear or read of a transaction at second hand; or artificial and fabulous, as where their imaginations are raised, and the action is, as it were, reacted before them.

NATROLITE, in mineralogy, a species of the zeolite family, was first described and analyzed by Klaproth, who gave it the name which it bears, on account of the great proportion of soda which it contains. It occurs massive, and in its fracture presents straight or diverging fibres; its colour is light yellow; with little lustre; it is striped, and the stripes are curved in the direction of the external surface. It fuses very readily before the blow-pipe. It consists of

Silica	48
Alumina	24.25
Soda	16.5
Oxide of iron	1.75
Water	9
	99.5
Loss	5
	100

NATRON, in chemistry, a term frequently given to soda, upon the supposition that it is the natron or nitrum of the ancients. See SODA. Natural natron occurs either as an efflorescence on the surface of the soil, or on decomposing rocks of particular kinds, or on the sides and bottoms of lakes that become dry during the summer. In Hungary the natron lakes are very numerous, and afford a vast quantity annually. In some places it effervesces on the surface of the soil, heath, &c. It is even found efflorescing on meadows, where it is renewed every spring. About sixty miles north-east of Grand Cairo, in Egypt, there is a limestone valley, in which there are several extensive natron lakes, which become dry during the summer season, and leave their sides and bottoms covered with a great quantity of soda or natron.

NATURAL *history*. Natural history, taken in its most extensive sense, signifies a knowledge and description of the whole universe. Facts respecting the heavenly bodies, the atmosphere, the earth, and indeed all the phenomena which occur in the world, and even those which relate to the external parts, as well as the actions of man himself, so far as reason can discover them, belong to the province of natural history. But when we leave the simple recital of effects, and endeavour to investigate the causes of such phenomena, we over-step the boundaries of natural history, and enter on the confines of philosophy. This science, it must be evident, according to the above definition, is as extensive as nature itself: but in a more appropriate and limited sense, it treats of those substances of which the earth is composed, and of those organized bodies, whether vegetable or animal, which adorn its surface, soar into the air, or dwell in the bosom of the waters.

In this restricted sense natural history may be divided into two heads; the first teaches us the characteristics or distinctive marks of each individual object, whether animal, vegetable, or mineral; the second renders us acquainted with all its peculiarities, in respect to its habits, its qualities, and its uses. To facilitate the attainment of the first, it is necessary to adopt some system of classification, in which the individuals that correspond in particular points may be arranged together, and with this view we have preferred that of Linnæus, as being the most simple of any that has yet been presented to the public.

A knowledge of the second head can only be acquired by a diligent and accurate investigation of each particular object; for this we must refer the reader to the several genera described in the course of the work, under which we have endeavoured to give a brief account of the interesting and more material facts connected with each genus.

The study of natural history consists in the collection, arrangement, and exhibition of the various productions of the earth. These are divided into three great kingdoms of nature, the boundaries of which meet in the ZOOPHYTES, which see.

Minerals occupy the interior parts of the earth, in rude and shapeless masses; but most of them may be sometimes found crystallized so regularly, that they may be determined by the measurement of their angles with mathematical precision. They are concrete bodies, destitute of life and sensation. See MINERALOGY, and the several genera of minerals.

Vegetables clothe its surface with verdure, imbibe nourishment through their bibulous roots, respire by means of leaves, and continue their kind by the dispersion of seeds within prescribed limits. They are organized bodies, possessing life, but not sensation. See BOTANY.

Animals inhabit the exterior parts of the earth, respire and generate eggs: are impelled to action by hunger, affections and pain, and, by preying on other animals and vegetables, restrain within proper limits and proportions the numbers of both. They possess organized bodies, enjoy life and sensation, and have the power of loco-motion.

Man, who rules and subjugates all other beings, is, by his wisdom alone, capable of forming just conclusions from such natural bodies as present themselves to his senses. Hence an acquaintance with these bodies, and the capability, from certain marks imprinted on them by the hand of nature, to distinguish them from each other, and to affix to each its proper name, constitute the first step of knowledge. These are the elements of this science; this is the great alphabet of nature, for if the name be lost, the knowledge of the object must be lost also.

The method pursued in natural history indicates that every body may, on inspection, be known by its peculiar name, and this points out whatever the industry of man has been able to discover respecting it, so that, amid apparent confusion, the greatest order and regularity are discernible.

The Linnæan system is divided into classes, orders, genera, species, and varieties, to each of which their names and characters are affixed. In this arrangement, the classes, order, and genera, are arbitrary, but the species are natural.

Of the three grand divisions of the imperium naturæ, above referred to, the animal kingdom stands highest in the scale, next to it the vegetable, and lastly the mineral kingdom.

To the vegetable and mineral kingdoms we have already referred, under the distinct articles BOTANY and MINERALOGY: with regard to the animal kingdom, we may observe, that animals enjoy sensation by means of a living organization, animated by a medullary substance, perception by nerves, and motion by the exertion of the will. They are furnished with members for the different purposes of life, organs for their different senses, and faculties or powers for the application of their different perceptions. They all originate *ab ovo*. Their external and internal structure, habits, instincts, and various relations to each other, will be found under the different genera. See also ANATOMY, COMPARATIVE ANATOMY, PHYSIOLOGY, &c.

The following is a brief abstract of the arrangement pursued by Linnæus in his division of the animal kingdom.

CLASS I. MAMMALIA.

ORDER.

Primates
Bruta
Feræ
Glires
Pecora
Belluæ
Cete

CLASS II. AVES.

ORDER.

Accipetres
Picæ
Anseres
Grallæ
Gallinæ
Passeres

CLASS III. AMPHIBIA.

ORDER.

Reptilia
Serpentes

CLASS IV. PISCES.

ORDER.

Apodes
Jugulares
Thoracici
Abdominales
Branchiostegi
Condropterygii

CLASS V. INSECTA.

ORDER.

- Coleoptera
- Hemiptera
- Lepidoptera
- Neuroptera
- Hymenoptera
- Diptera
- Aptera

CLASS VI. VERMES.

ORDER.

- Intestina
- Mollusca
- Testacea
- Zoophyta
- Infusoria

For particular information respecting the characters of the different classes, orders, &c. the reader may consult the several articles.

NATURALIZATION, is when an alien born is made the king's natural subject.

Hereby an alien is put in the same state as if he had been born in the king's ligeance, except, only, that he is incapable of being a member of the Privy Council, or Parliament, and of holding any office or grant. No bill for a naturalization can be received in either house of Parliament, without such disabling clause in it; nor without a clause disabling the person from obtaining any immunity in trade thereby, in any foreign country, unless he shall have resided in Britain seven years next after the commencement of the session in which he is naturalized. Neither can any person be naturalized, or restored in blood, unless he have received the sacrament within one month before the bringing in of the bill, and unless he also take the oaths of allegiance and supremacy in the presence of the parliament. See Alien.

NATURAL *philosophy*, otherwise called *physics*, is that science which considers the powers of nature, the properties of natural bodies, and their actions upon one another. Laws of nature are certain axioms, or general rules, of motion and rest, observed by natural bodies in their actions upon one another. Of these laws Sir I. Newton has established three:— Law 1. That every body perseveres in the same state, either of rest or uniform rectilinear motion, unless it is compelled to change that state by the action of some foreign force or agent. Thus projectiles persevere in their motions, except so far as they are retarded by the resistance of the air, and the action of gravity: and thus a top, once set up in motion, only ceases to turn round because it is resisted by the air, and by the friction of the plane upon which it moves. Thus also the larger bodies of the planets and comets preserve their progressive and circular motions a long time, undiminished, in regions void of all sensible resistance. As body is passive in receiving its motion, and the direction of its motion, so it retains them, or perseveres in them, without any change, till it be acted upon by something external. Law 2. The motion, or change of motion, is always proportional to the moving force by which it is produced, and in the direction of the right line in which that force is impressed. If a certain force produce a certain motion, a double force will produce double the motion, a triple force triple the motion, and so on. And this motion, since it is always directed to the same point with the generating force, if the body were in motion before, is either to be added to it, as where the motions conspire; or subtracted from it, as when they are opposite; or combined obliquely, when oblique: being always compounded with it according to the denomination of each. Law 3. Re-action is always contrary and equal to action; or the actions of two bodies upon one another are always mutually equal, and directed contrary ways, and are to be estimated always in the same right line. Thus, whatever body presses or draws another is equally pressed or drawn by it. So, if I press a stone with my finger, the finger is equally pressed by the stone: if a horse draw a weight forward by a rope, the horse is equally opposed or drawn back towards the weight; the equal tension or stretch of the rope hindering the progress of the one, as it promotes that of the other. Again, if any body, by striking on another, do in any manner change its motion, it will, itself, by means of the other, undergo also an equal change in its own motion, by reason of the equality of the pressure. When two bodies meet, each endeavours to persevere in its state, and resists any change; and because the change which is produced in either may be equally measured by the action which it excites upon the other, or by the resistance which it meets with from it, it follows that the changes produced in the motions of each are equal, but are made in contrary directions: the one acquires no new force but what the other loses in the same direction; nor does this last lose any force but what the other acquires;

and hence, though by their collisions motion passes from the one to the other, yet the sum of their motions, estimated in a given direction, is preserved the same, and is unalterable by their mutual actions upon each other. In these actions the changes are equal; not those, we mean, of the velocities, but those of the motions or momenta; the bodies being supposed free from any other impediments. For the changes of velocities, which are likewise made contrary ways, inasmuch as the motions are equally changed, are reciprocally proportional to the bodies or masses.

NATURALIST, a person well versed in the study of nature, and the knowledge of natural bodies, especially in what relates to animals, vegetables, metals, minerals, and stones. See NATURAL HISTORY.

NATURE, according to Mr. Boyle, has eight different significations; it being used, 1. For the author of nature, whom the schoolmen call *natura naturans*, being the same with God. 2. By the nature of a thing, we sometimes mean its essence; that is, the attributes which make it what it is, whether the thing be corporeal or not; as when we attempt to define the nature of a fluid, of a triangle, &c. 3. Sometimes we confound that which a man has by nature with what accrues to him by birth; as when we say, that such a man is noble by nature. 4. Sometimes we take nature for an internal principle of motion; as when we say, that a stone by nature falls to the earth. 5. Sometimes we understand by nature the established course of things. 6. Sometimes we take nature for an aggregate of powers belonging to a body, especially a living one; in which sense physicians say, that nature is strong, weak, or spent; or that, in such and such diseases, nature left to herself will perform the cure. 7. Sometimes we use the term nature for the universe, or whole system of the corporeal works of God; as when it is said of a phœnix, or chimera, that there is no such thing in nature. 8. Sometimes too, and that most commonly, we express by the word nature a kind of semi-deity, or other strange kind of being.

If, says the same philosopher, I were to propose a notion of nature, less ambiguous than those already mentioned, and with regard to which many axioms, relating to that word, may be conveniently understood, I should first distinguish between the universal and the particular nature of things. Universal nature I would define to be the aggregate of the bodies that make up the world, in its present state, considered as a principle; by virtue whereof they act and suffer, according to the laws of motion prescribed by the author of all things. See the articles BODY, INERTIA, MOTION, &c. And this makes way for the other subordinate notion; since the particular nature of an individual consists in the general nature, applied to a distinct portion of the universe; or, which is the same thing, it is a particular assemblage of the mechanical properties of matter, as figure, motion, &c.

Those who desire a more particular discussion of each of these opinions, may consult Boyle's "Free Inquiry into the Vulgar Notion of Nature." By a modern French writer we have the following account of Nature. This word, which we so frequently employ, must only be regarded as an abridged manner of expressing, sometimes, the results of the laws to which the Supreme Being has subjected the universe; at others, the collection of beings which have sprung from his hands. Nature, contemplated thus under its true aspect, is no longer a subject of cold and barren speculation with respect to morals: the study of its productions, or of its phenomena, is no longer bounded to enlightening the mind; it affects the heart, by kindling therein sentiments of reverence and admiration at the sight of so many wonders, bearing such visible characters of an infinite power and wisdom. Such was the disposition that was cultivated by the great Newton, when, after having considered the mutual connection which subsists between effects and their causes, which makes all the particulars concur to the harmony of the whole, he elevated his mind to the idea of a Creator and Prime Mover of matter, and enquired of himself why nature had made nothing in vain? whence it happens that the sun, and the planetary bodies, gravitate the one towards the other, without any intermediate dense matter? and, how it could be possible, that the eye should be constructed without the knowledge of optics, or the organ of hearing without the intelligence of sounds?

NAVAL *affairs*, comprehend whatever relates to navigation, ship-building, sailors, &c. See NAVIGATION, SHIP-BUILDING.

NAUCLEA, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Aggregatæ. Rubiaceæ, Jussieu. Essential character: corolla funnel-form; seed one, inferior, two-celled; receptacle common globular. There are four species, of which N. parviflora is a beautiful large tree, growing naturally in almost every part of the coast of Coromandel, but chiefly among the mountains, flowering during the cold season; the wood is of a light chesnut colour, firm and close grained; it is used for various purposes, where it can be kept dry; if exposed to moisture it very soon decays. It is called by the Telingas, bota cadamic.

NAUDE, (Philip) in biography, an able professor of mathematics at Berlin in the seventeenth and early part of the eighteenth century, was born at Metz in Lorrain, in the year 1654. At the age of about twelve, he was taken into the service of the court of Eysenach, in the capacity of page, and attended on the young princes. In this situation his behaviour secured him the esteem of all who knew him; and while he continued here he learned the German language, which afterwards proved of great use to him. When he had spent about four years at Eysenach, his father chose to take him home; but how he was employed during the next fifteen years of his life we are not informed. We are only told that his father had neither the intention nor the means of affording him a learned education; but that, notwithstanding the disadvantages of his condition, having an unconquerable thirst for knowledge, he became his own master, and made considerable proficiency in different branches of learning, particularly in the mathematical sciences. As he was in principle a Protestant, when the edict of Nantes was revoked in 1685, he left France, with his wife and young child about nine months old, and resided about two years at Hanau. Hence he removed to Berlin, where he contracted an intimacy with M. Langerfield, mathematician to the court, and tutor to the pages. This gentleman, who knew how conversant he was with the sciences, advised him to open a mathematical school, and recommended pupils to him. In 1687, he received an appointment to teach arithmetic and the elements of the mathematics at the college of Joachim: and in 1690, he was made secretary interpreter. Upon the death of M. Langerfield not many years afterwards, M. Naude succeeded him in 1696, both in his employments at court, and the professorship in the Academy of Sciences. In 1701 he was elected a member of the Academy of Sciences; and in 1704, when the king founded the Academy of Princes, M. Naude was attached to it by a special patent, as professor of mathematics. He died at Berlin in 1729, at the age of seventy-five, highly respected for his integrity and general excellence of character. Though the mathematics chiefly occupied his attention, he was not unacquainted with the other sciences, and as he was zealous for the religion which he professed, he had made divinity his particular study, and written several treatises on religious and moral subjects. In mathematics, his sole publication was "Elements of Geometry," in quarto, written in German, and printed at Berlin for the use of the Academy of Princes; and some smaller pieces, which appeared at different periods in the "Miscellanea Berolinensia." Among his theological and moral productions were, "Sacred Meditations," 1690, 12mo: "Evangelical Morality," 1699, in two volumes, 12mo.; "The Sovereign Perfection of God in his Divine Attributes, and the perfect integrity of the Scriptures, in the sense maintained by the first Reformers," 1708, in two volumes, 12mo. written against M. Bayle; which being attacked, in a 12mo. pamphlet, he defended in "A Collection of Objections to the Treatise on the Sovereign Perfection of God, with Answers to the same," 1709, 12mo.; "An Examination of two Treatises of M. de Placette," 1713, in two volumes, 12mo.; "Dialogue in Solitude," partly translated from the Dutch of William Tecklink, 1727, 12mo.; "A refutation of the Philosophical Commentary," 1718, 12mo. &c.

NAVEL, in anatomy, the centre of the lower part of the abdomen; being that part where the umbilical vessels passed out of the fœtus to the placenta of the mother. See Anatomy, Midwifery, &c.

NAVIGATION is the art of conducting a vessel from one port to another, by observation of the heavenly bodies, calculation of the distance, or way, made daily, and by steering such a course, under guidance of the compass, as may lead, in the most direct manner, from the place quitted to the ship's destination. Before we proceed on this topic, it may be proper to stipulate for a competent knowledge of geography; especially of the division of our globe, by the various circles and meridians, by which it is intersected in theory. The student must also be thoroughly acquainted with all relating to the needle; in particular the dip and variation, and be able to take an account of the ship's progress numerically, or, as it is termed, in dead-reckoning; and if he should possess some skill in geometry and trigonometry, he will find that his task is more easily performed, and that he will, in due time, render himself conspicuous in that branch of his honourable profession.

We shall preface this subject with a few details that will be found useful: they will prepare the way for farther operations; and serve, in addition to what has been premised in regard to mathematical acquirement, to give such a solid foundation, as will leave the reader at no loss as he proceeds in the more intricate parts of the science. We shall commence with the absolute necessity of readily boxing, *i. e.* telling the points of the compass. Under the head of MAGNETISM, we have slightly touched on this subject, but shall now explain, that each quarter of the compass card, or index, is divided into eight equal portions called points. The four cardinal points, *i. e.* North, South, East and West, form the terminations of two diameters standing at right angles: the four points ascertained by dividing the several quadrants into two equal portions each, give compound points; which are named after the two adjunct cardinals respectively; observing that North and South have precedence in each designation. Thus the mid-point between North and East is called "North East;" that between North and West is called "North West;" that between South and East is called "South East;" and that between South and West is called "South West." By this process we have divided the circumference into eight equal parts. Now let each segment between the several cardinals, and their compounds, be subdivided into four equal portions; so that the whole circle may be partitioned into thirty-two parts; *i. e.* eight between each of the adjunct cardinals; the two points adjunct to North will be "North by East," and "North by West;" those adjunct to South will be "South by East," and "South by West;" those adjunct to East will be "East by North," and "East by South;" while the adjuncts to West will be "West by North," and "West by South." The two adjuncts to the compounds will be as follow; to North East they will be "North East by North," and "North East by East;" to South East they will be "South East by South," and "South East by East;" to North West they will be "North West by North," and "North West by West;" and to South West they will be "South West by South," and "South West by West." There yet remain eight points, equidistant between the several cardinals and the compounds: these have their designations made by prefixing, to that of the adjunct compound, that of the cardinal to which it is nearest. Thus between North and North West, the point is called "North, North West," and that between North West and West, is called "West, North West:" thus we have "North, North East," and "East, North East;" "South, South West," and "West, South West;" "South, South East," and "East, South East."

In Plate IX. Miscel. fig. 9 and 10, we have given figures of a compass and compass-card, according to the mariner's arrangement just described, in which only the initials are shewn: the North point being distinguished, as it always is, by a fluer de lys, or some particular indicial ornament. For further particulars, see MARINER's *compass.*

We have been the more particular in describing the formation of the compass card, because a perfect knowledge of that important aid is indispensably necessary for all who attempt the study, or follow the practice, of navigation. Under the head of MAGNETISM we have explained the properties of the load-stone, and spoken of the dip of the needle, as well as of the variation which exists between the true and apparent polar directions; as indicated by the compass. Therefore we shall briefly observe, that variation is either Easterly or Westerly; and, whenever it prevails, must be computed in the reckoning; always making allowance for the difference, and laying down the ship's course accordingly. Thus if a ship sails due North, and that six degrees of Western variation are known to prevail in that part where the vessel is sailing, instead of sailing due North, as indicated by the compass, the vessel must sail six degrees more Easterly, or, in other words, North half East, *i. e.* half a point Easterly of North, in which direction the true North point would be found by observation of the heavenly bodies. Currents must also have allowance made for them according to their bearing, or the points to which they run: it is self-evident, that if such were not duly ascertained, and set off from the dead reckoning, the ship's place would never be accurately laid down, and destruction would inevitably follow the neglect.

The way, or distance, the ship sails within the day, is ascertained by means of a small piece of board called the Log, (which see); that being fastened to a thin, but stout line, and lowered over the stern, occasions the line to run off from a large reel. The line being marked at certain distances with small pieces of string, whereon one, two, three, &c. knots are made, at distances corresponding with the rate per hour, and the person who superintends the process, having a minute or a half minute glass, the log is allowed to run the line from the reel, during such interval; the number of knots, on the proximate string, indicating the number of miles the ship sails within the hour. Hence the technical term of so many "knots per hour;" or "an eight knot breeze," &c.

The whole world is supposed to be comprised under a circle, which, in every direction, contains 360 degrees of equal measurement. Such as pass through the meridian of any place, and from North to South, cutting the equator at right angles, are called meridional lines, and are each divided into nine degrees, counting from the line towards the poles respectively: those proceeding to the north are called degrees of North latitude; those towards the South being called degrees of South latitude. In this respect all civilized nations are agreed: but in their estimation of longitude, they generally differ, each taking some particular point within their own dominions as zero, and counting 180 degrees East, and as many West; calling the former East longitude, the latter West longitude. Consequently, the union of those adverse designations takes place at the antipodes of the zero from which they proceeded; and the moment a vessel passes 180 degrees either way, she enters upon 179 of the opposite semicircle, and reckoning the degrees of latitude are equal from the equator to the pole; and each in general measures about 69½ of British statute miles. But the degrees of longitude vary greatly; decreasing regularly from the equator to the poles, where they all meet, and are, as it were, annihilated. The regular declension of the circles of longitude, which are the same as parallels of latitude, may be seen under the head of Dialling; where, in the construction of lines of latitude, their gradual decrease is fully exhibited: see also Longitude, for a table of longitudes in various latitudes.

A rhumb-line is a right line drawn from the centre of the compass to the horizon, and is named from that point of the horizon it falls upon. The course is the angle which any rhumb-line makes with the meridian, and is sometimes reckoned in degrees, and sometimes in points of the compass; so that if a ship sail upon the second rhumb, or N. N. E. the course is 22° 30′, and so for any other. When a ship makes a direct course from one point or port to another, and that there is no current nor any variation of the compass, she sails "on a rhumb;" that is, she is guided invariably from one to the other throughout her course by one point of the compass, being governed throughout her passage by that line only. This is different from what is called traverse sailing, which arises from adverse winds, or sometimes from currents, and obliges a vessel to change her course occasionally; especially where the vicinity of land renders it necessary to steer at times differently; lest the current, which generally changes from one side or direction to another, should set her against the shore. When the wind is diametrically, or obliquely, against a ship's direct course, she must make traverses, *i. e.* ziz-zags, which is effected by laying her head as close to the wind as may allow her sails to be filled when close hauled; (see Plate XI. Miscel. fig. 12.) in which A is the place of departure, B the point of destination, from which the wind blows direct, and A *b*, *b c*, *c* B, &c. the course the ship must steer to arrive at B. Square rigged ships generally can lay within six points of the wind; but sloops, &c. commonly lay up within four points and a half. When working in this manner, it is called "beating," or "playing to windward;" when the wind blows straight upon the side of the vessel, it is said to be "on the beam;" when between her side and stern, it is called "a quartering wind," or "on her quarter;" when direct astern, or near it, she is said to be "before the wind," or to "sail large." When the wind from being fair becomes suddenly foul, it is said to "take her aback."

In traverse sailing, the vessel's head is usually turned up "into the wind" when she is "put about." This is called "tacking;" but if, instead of "throwing her up" in that manner, she is allowed to go round from the wind until it comes or is met by her on the other side, it is called "wearing." When she has the wind on her starboard, or right bow, she is said to "have her starboard tacks aboard," and *vice versa*, when the larboard or left bow is to the wind. To know how close a ship will lay to the wind, observe the course she goes on each tack, say north on one, and south-west on the other; divide in the middle, and her course will appear to be west-north-west. But allowance must be made for lee-way, which is the loss made by the impression made on the vessel as she is working to windward; when the wind presses her from the direct line of her course, and occasions her to "drift to leeward." See **Leeway**.

The following is the established rule for laying down a traverse course on paper. Having drawn the meridian and parallel of latitude (or east and west line) in a circle representing the horizon of the place, mark in the circumference the place of the wind, that is, the point from which it blows; draw your rhumb passing through the place bound to, and lay thereon the distance of that place from the centre; on each side of the wind lay off in the circumference those points, or degrees, that shew how near the wind the vessel can lie, and draw their rhumbs. Now the first course will be one of these rhumbs, according to the tack the ship first sails upon; when she goes on the other tack, it will be at such an angle as may correspond with her ability to lay near the wind; but, in general, for square-rigged vessels the angle should be twelve points, (*i. e.* six for the distance on each tack, as shewn in fig. 12.) But where the wind is not directly adverse, it would be improper to make the tacks towards both rhumbs of equal duration or length. Therefore that tack should be longest which lays nearest the intended course; the other (*i. e.* "the board") should be short, so that the vessel should not go too far from the intention, but adhere as much as may be practicable to the rhumb of her course, as shewn in fig. 13, in which the arrow shews the wind's locality at three points east of the destination B.

To resolve a traverse, is to reduce and bring several courses into one; the course are known by the compass, the distance by the log: while the dead-reckoning they produce is corrected by daily observation of the sun and other planets, whenever opportunity offers.

In constructing figures relating to a ship's course, let the top of the paper always represent the north: your meridian is described perpendicular thereto, and your chart may either be in squares, for degrees, or five or ten degrees, or it may be divided according to the projected tables now in common use (see **Longitude**) and which is by far the best, as it shews the real distances and bearings, according to the actual positions of places, as proved by observation. In that table the letters D. L. imply the degree of latitude, measured from the equator, either northwards or southwards; in the columns of miles corresponding thereto, you will see how many miles, of sixty to a degree, called geographical miles, are contained in each degree of longitude under such latitudes. Thus, if I would know how many miles are contained in a degree in latitude 18; I find there are 57.06. Therefore it must be evident, that, as the latitude recedes from the equator, the smaller the degrees of longitude become: hence, if a vessel could sail round the north pole in latitude 80°, where there are only 10° 42′ miles in a degree of latitude, and were to run 123 miles in the twenty-four hours, she would sail ten times round the pole, and indeed round the world, in that time, and see the sun rise and set no less than twelve times!

From this we are satisfied, that the old practice of laying down a chart, or map, in square degrees, was erroneous in the extreme; and that what is called "Mercator's projection," which gives every degree its just and exact value in breadth, at both its northern and southern extremities, is the only correct and rational mode of description.

We shall now give the reader a few examples under the head of plane sailing, which supposes the earth to be a perfect level, or plane. This is but the application of plane trigonometry to the solution of the several variations; where the hypothenuse, or longest side, is always the rhumb on which the ship's course lies. The perpendicular is the difference of latitude counted on the meridian, and the base the departure (which is either easting or westing) counting from the meridian. The angle opposite the base is that which the ship makes with the meridian: the angle at the perpendicular is the complement of the course; which, taken together, always make 90 degrees, or eight points. When the course is given in degrees, they must be set off from a line of chords of 60, corresponding with the radius of the circle, or quadrant, drawn either easterly or westerly, as the ship's course may be from the meridian. Where the course is given in points, it may be set down with its corresponding logarithm in points in the calculation, as found in the first page of logarithms in general. In all cases, wherever the complement course is used, the degrees or points put down correspond with the course itself; yet the logarithm belonging to the complement of that course is taken.

Example 1. "Course and distance sailed being given, to find the difference of latitude, and the departure from the meridian." Suppose a ship from the Lizard, in the latitude of 49° 57′ north, sails S. W. by W. 496 miles; required the latitude come to, and her departure from the meridian. Draw the meridian, or difference of latitude; with the chord of 60° in your compasses, and one foot in C, fig. 14, describe an arch: take 56° 15′, or five points, in your compasses, and lay off that distance upon the arch, from BC towards CA: through the point where it cuts draw the distance CA, upon which set off 496: from A let fall the perpendicular AB, the departure, and it is done. For AB, being measured on the same scale that AC was, will give the departure 412.4, and BC 275.6 for the difference of latitude.

Example 2. "Course and difference of latitude being given, to find the distance run, and the departure from the meridian." If a ship runs S. E. by E. from 1° 45′ north latitude, and then by observation is in 2° 50′ south latitude, required her distance and departure? As the ship has crossed the line (*i. e.* the equator) the north latitude 1° 45′ must be added to the south latitude 2° 50′; which makes the difference of latitude 4° 35′. Multiply that by 60, and there appear 275 geographical miles. Now draw BC (fig. 15) equal to 275; and BA, making an angle with BC equal to five points, or 56° 15′; upon C erect the perpendiculars CA, to join BA in A. Then will CA be 112, and AB 496 miles; therefore the ship's run has been 496 miles, and her departure from the meridian 411.6 easterly.

Example 3. "Course and departure being given, to find the distance and the difference of latitude." If a ship sails N. E. by E. ¾ E. from a port in 3° 15′, south latitude, until she depart from her first meridian 412 miles, what latitude will she be in? Draw DA (fig. 16) upon which erect the perpendicular AB; draw the line AC, making an angle with AB equal to 64° 41′, corresponding with 5¾ points. At the distance of 412 miles draw DC, parallel to AB, to cut AC in C; through the point C draw BC parallel to AD, to cut the meridian AB. Thus AC will give 456 miles for the distance run, and AB 195 miles for difference of latitude.

Having said thus much by way of general information, we must refer those readers, who are in search of extensive knowledge in the art of navigation, to the several treatises which have been written by its professors; among which, we believe, those published by Mr. Nicholson and the late John Hamilton Moore, have had the greatest character for utility and general accuracy. With respect to what appertains more to the examination of harbours, coasts, soundings, &c. we refer to SURVEYING.

Under the article QUADRANT, the mode of taking observations at sea will be given, for ascertaining the latitude by solar observation.

NAUSEA, in medicine, a reaching or propensity and endeavour to vomit, arising from a loathing of food, excited by some viscous humour that irritates the stomach.

NAUTILUS, in natural history, a genus of the Vermes Testacea class and order. Shell univalve, divided into several departments, communicating with each other by an aperture. There are more than thirty species, separated into sections. A. spiral, rounded, with contiguous whorls. B. spiral, rounded, with separated whorls. C. elongated and straightish. N. pompilius inhabits the Indian and African oceans; often very large, and finely variegated with brown flexuous streaks, spots, and marks, under the outer covering, which is white; within of a most beautiful pearly gloss. Of this species, the inhabitants of the east make drinking cups. N. spicula, aperture of the shell orbicular; whorl cylindrical: it inhabits the American and Indian oceans; about an inch in diameter; whitish within, shining like mother-of-pearl; orbicular; the whorls gradually decreasing inwards, the first a little straight; siphon contiguous to the internal margin.

NAVY, the fleet or shipping of a prince or state.

The management of the British navy royal, under the Lord High Admiral of Great Britain, is entrusted to principal officers and commissioners of the navy, who hold their places by patent. The principal officers of the navy are four; *viz.* The Treasurer, whose business it is to receive money out of the exchequer, and to pay all the charges of the navy, by warrant from the principal officers: Comptroller, who attends and comptrols all payment of wages, is to know the rates of stores, to examine and audit all accounts, &c. Surveyor, who is to know the states of all stores, and see wants supplied, to estimate repairs, charge boat-swains, &c. with what stores they receive, and at the end of each voyage to state and audit accounts: Clerk of the Acts, whose business it is to record all orders, contracts, bills, warrants, &c.

The Commissioners of the navy are five; the first executes that part of the Comptroller's duty which relates to the comptrolling the Victualler's accounts; the second another part of the said Comptroller's duty, relating to the account of the store-keepers of the yard: the third has the direction of the navy at the port of Portsmouth; the fourth has the same at Chatham; and the fifth at Plymouth.

There are also other Commissioners at large, the number more or less, according to the exigencies of public affairs; and since the increase of the royal navy, these have several clerks under them, with salaries allowed by the king.

The victualling of the royal navy had formerly been undertaken by contract, but is now managed by Commissioners, who hold their office at Somerset-House Strand.

NEBULÆ, in astronomy. There are spots in the heavens, called Nebulæ, some of which consist of clusters of telescopic stars, others appear as luminous spots, of different forms. The most considerable is one in the midway, between the two stars on the blade of Orion's sword, marked θ by Bayer, discovered in the year 1656, by Huygens; it contains only seven stars, and the other part is a bright spot upon a dark ground, and appears like an opening into brighter regions beyond.

Dr. Halley, and others, have discovered nebulæ in different parts of the heavens. In the "Connoissance des Temps," for 1783, and 1784, there is a catalogue of 103 nebulæ, observed by Messier and Mechain. But to Dr. Herschel we are indebted for catalogues of 2000 nebulæ, and clusters of stars, which he himself has discovered. Some of them form a round compact system, others are more irregular, of various forms, and some are long and narrow. The globular system of stars appear thicker in the middle than they would do, if the stars were all at equal distances from each other; they are, therefore, condensed towards the centre. That stars should be thus accidentally disposed is too improbable a supposition to be admitted; he supposes, therefore, that they are brought together by their mutual attractions, and that the gradual condensation towards the centre is a proof of a central power of such a kind. He observes, also, that there are some additional circumstances in the appearance of extended clusters and nebulæ, that very much favour the idea of a power lodged in the brightest part. For although the form of them be not globular, it is plain that there is a tendency to sphericity. As the stars in the same nebulæ must be very nearly all at the same relative distances from us, and they appear nearly of the same size, their real magnitudes must be nearly equal. Granting, therefore, that these nebulæ and clusters of stars are formed by mutual attraction, Dr. Herschel concludes that we may judge of their relative age by the disposition of their component parts, those being the oldest which are most compressed. He supposes, and indeed offers powerful arguments to prove, that the milky way is the nebulæ of which our sun is one of its components.

Dr. Herschel has also discovered other phenomena in the heavens, which he calls nebulous stars; that is, stars surrounded with a faint luminous atmosphere of large extent. Those which have been thus styled by other astronomers, he says, ought not to have been so called, for on examination they have proved to be either mere clusters of stars, plainly to be distinguished by his large telescopes, or such nebulous appearances as might be occasioned by a multitude of stars at a vast distance. The milky way consists entirely of stars; and he says, "I have been led on by degrees from the most evident congeries of stars, to other groups in which the lucid points were smaller, but still very plainly to be seen; and from them to such, wherein they could but barely be suspected, until I arrived at last to spots in which no trace of a star was to be discerned. But then the gradations to these latter were by such connected steps, as left no room for doubt but that all these phenomena were equally occasioned by stars variously dispersed in the immense expanse of the universe."

In the same paper is given an account of some nebulous stars, one of which is thus described: "Nov. 13, 1790. A most singular phenomenon! A star of the eighth magnitude, with a faint luminous atmosphere, of a circular form, and of about 3′ in diameter. The star is perfectly in the centre, and the atmosphere is so diluted, faint, and equal throughout, that there can be no surmise of its consisting of stars, nor can there be a doubt of the evident connexion between the atmosphere and the star. Another star, not much less in brightness, and in the same field of view with the above, was perfectly free from any such appearance." Hence, Dr. Herschel draws the following consequences: Granting the connexion between the star and the surrounding nebulosity, if it consist of stars very remote, which gives the nebulous appearance, the central star, which is visible, must be immensely greater than the rest; or if the central star be no bigger than common, how extremely small and compressed must be those other luminous points which occasion the nebulosity. As, by the former supposition, the luminous central point must far exceed the standard of what we call a star; so in the latter, the shining matter about the centre will be too small to come under the same denomination; we, therefore, either have a central body which is not a star, or a star which is involved in a shining fluid, of a nature totally unknown to us. This last opinion Dr. Herschel adopts.

Light reflected from the star could not be seen at this distance. Besides, the outward parts are nearly as bright as those near the star. Moreover, a cluster of stars will not so completely account for the milkiness, or soft tint of the light of these nebulæ, as a self-luminous fluid. "What a field of novelty," says Dr. Herschel, "is here opened to our conceptions. A shining fluid, of a brightness sufficient to reach us from the regions of a star of the 8th, 9th, 10th, 11th, 12th magnitude, and of an extent so considerable as to take up 3, 4, 5, or 6 minutes in diameter." He conjectures that this shining fluid may be composed of the light perpetually emitted from millions of stars. See Philos. Trans. vol. lxxxi. p. 1. on Nebulous Stars, properly so called.

NEBULY, or Nebulée, in heraldry, is when a coat is charged with several little figures, in form of words, running within one another, or when the outline of a bordure, ordinary, &c. is indented or waved.

NECESSITY, whatever is done by a necessary cause, or a power that is irresistible, in which sense it stands opposed to freedom.

Necessity, *philosophical*. The advocates of philosophical necessity maintain, that the volitions and actions of intelligent agents are produced by causes, equally deciding and resistless as those which are admitted to actuate the material system of the universe. Wherever the sun shines, or the rain descends, it is impossible to conceive, that in situations precisely similar to those which immediately precede these events, the ray should be withheld, or the cloud should remain suspended in the atmosphere. The diffused splendour, and the falling moisture, are universally allowed to be in such situations invariably and inevitably the results.

The doctrine of necessity extends to the mind what is thus obvious and uncontradicted with respect to matter. It insists on the absolute and uncontrollable influence of motives upon the human will and conduct. It asserts, that the determinations and actions of every individual flow, with unfailing precision and resistless operation, from the circumstances, motives, or states of mind by which they are preceded; and that, in the whole series of his existence no specific feeling, thought, or act, could have been different from what it really was, these previous circumstances continuing the same. In the consideration of this subject, it is important not to confound necessity with compulsion, as the latter implies that the choice of the mind is effected with reluctance, and in consequence of the exercise of force upon inclination; whereas, whether the conclusion be formed with the full concurrence of the affections, or after a conflicting estimate, which leaves reason completely triumphant over inclination; the mind is equally impelled by some controlling energy, and equally necessitated to the determination it adopts. It is of consequence also to the illustration of the subject, fully to comprehend the meaning of the term motive, which, it is to be remembered, comprehends both the bias of the mind and the end in view, and includes every thing that moves or influences the mind, and excites it to a choice or determination.

The grand argument in support of philosophical necessity is derived from the relation of cause and effect. If there be any one principle in which mankind, in all their reasonings upon natural objects, have more perfectly concurred than in any other, it is the maxim, that every effect requires a cause, or, in other words, that whatever begins to be, demands some antecedent circumstances tending to its production. Of the nature indeed of causation we are completely and profoundly ignorant. But from the invariable connexion between certain previous and certain subsequent circumstances in the world of matter, we infer the tendency of the former to accomplish the latter, and the indispensableness of the operation of the first to the existence of the phenomena immediately following, with the same confidence, as if a perfect acquaintance with the arcana of nature had unfolded to us its necessity. The association of ideas in our minds, arising from the unvarying connexion between certain preceding and subsequent appearances around us, becomes at length so fixed, that the observation of the first excites the undoubting expectation of the last; and where any effects produced differ from what we have been used to observe, and consequently to expect, we instantly presume that the preceding circumstances must proportionally have varied, and without an alteration in these, an alteration in the effect is pronounced impossible. Now, though we predict the acts of moral agents with less certainty, and expect them with more hesitation than mingle in our calculations on natural phenomena, this difference is attributable merely to our ignorance of the tempers, characters, and situations of those agents, to the difficulty, and frequently the impossibility, which we experience of exploring the labyrinth of the human heart, and nothing in the slightest degree to any doubt, that volitions will always be precisely determined by preceding states of mind, and that certain volitions will inevitably be productive of certain acts. As, with regard to natural objects, we are led to consider some things the cause of others, concluding them to possess over these others a necessary and causative operation from their invariable conjunction, so particular states of mind, being uniformly observed to be connected with particular determinations, are equally regarded as causes of which these determinations are the effects. The generative and irresistible influence of the motive upon the determination is inferred with as much justness and conviction as that of a certain degree of heat on liquifaction, or of cold on congelation; and a change of determination in the mind, while preceding circumstances continued the same, is considered equally impossible as that iron should swim, precisely in the same circumstances in which it previously sunk; or heat congeal, exactly in the same circumstances in which it has been uniformly observed to liquify. Thus, in the world of mind, as well as matter, no change of event takes place without a correspondent alteration in preceding circumstances, leading to it and operating upon it. This principle lies at the foundation of all clear reasoning and legitimate conclusion. Its denial would subvert all the forms and degrees of human knowledge. All fair inference, reasonable expectation, and judicious effort, would completely cease. Ignorance and confusion, hesitation and despair, would supersede all wise arrangement, lively hope, and heroic enterprize; and the noble fabric of the universe, abounding in evidences of the most wise and kind design, might have started into being without any intelligent cause or preceding operation. But a position thus leading to consequences the most monstrous and absurd must be totally groundless.

Every change, however minute or stupendous, however connected with unintelligent or moral nature, equally requires and possesses some cause of its existence. The steady resolves and brilliant career of virtue as necessarily result from preceding circumstances, as the harmonious movements of the solar system; and the irregularities of vice demand the operation of preceding impulses, equally with the wanderings of a meteor. Let any specific volition or determination be admitted at any time to exist in the mind: whence did it arise? Most certainly not uncaused; unless we are prepared by this reply to destroy all the common received opinions and feelings of mankind, and to admit that, though there was a period in which the order and beauty of the universe did not exist, they suddenly broke into being, unconnected with any circumstances whatever tending to accomplish so glorious a result. If this volition be stated to originate in a self-determining power, acting independently of motive, this self-determining power must be considered as in fact only a preceding volition, and the question, therefore, instead of being correctly and finally answered, is by this reply merely trifled with and evaded. Indisputably, the only proper answer that can be given is, that the particular determination alluded to, necessarily originated in the views and circumstances of the mind immediately previous to its adoption. These views and circumstances resulted from other situations which preceded them, and which were the consequences of others more remote. And thus in retrograde march we travel through a long series of mental feelings and operations, finding each linked indissolubly to that by which it was preceded, and constituting part of an immense chain, which soon extends beyond the reach of mortal eye, as much as it defies the controul of mortal power.

Another argument for the doctrine of philosophical necessity is drawn from the divine prescience. The foreknowledge of events must evidently preclude their contingency, for a contingent event is an event that either may or may not happen; but that which may not happen most evidently cannot be foreseen. The distinctions which have been made on this subject by the advocates of liberty have served to exhibit the perplexity of their authors, instead of contributing the slightest support to their cause. And with respect to the nature of the supreme mind, it is impossible to prove, or reasonably to believe, that the divine knowledge, infinitely superior as it unquestionably is to that of man, can embrace those things which are not the objects of knowledge, and exist so as to involve contradictions. To know that a contingent event will take place, would be to know that an event, which is decidedly and characteristically uncertain, is nevertheless certain, or, in other words, to know a thing to be what it is not. It is only by the expedient of limiting the divine prescience to events not dependent upon human choice, an expedient which some few have ventured to adopt, that the supporters of philosophical freedom can surmount this inconsistency; and the grossness of contradiction is thus exchanged for the flagrance of indecorum. To the believer in the absolute foreknowledge of God, the argument derived from it in support of the necessity of human actions may be considered as equally convincing with perhaps any argument, upon any subject that can be presented to the human understanding. If events are foreseen, they cannot be contingent. If they are contingent, they cannot be foreseen.

In addition to the arguments above adduced, may be added that arising from the consciousness which every man feels, of being influenced by some motive in the performance of every voluntary action. If any person attempt to accomplish an act, of whatever nature, whether of importance or insignificance, without the influence of some motive to decide, he will find himself completely baffled in the enterprize, and in every instance he will be able to assign the circumstances by which he was actually influenced. He will likewise find the spirit of his exertions uniformly proportioned to the animation of his motive. Where the motive is urgent, and arising from the union of inclination and conviction, his efforts will display all the activity of enthusiasm, and all the fortitude of heroism. And in correspondence with the lessening interest of motives, his enterprizes will decline in vigour, till, in the lowest instance, to adopt the language of our immortal poet, they are,

> "Sicklied o'er with the pale cast of
> thought,
> And lose the name of action."

The argument from consciousness, indeed, is applied by the asserters of philosophical liberty with equal confidence in support of their system; and it is insisted that all men imagine themselves possessed of liberty of choice, and must, therefore, if the opposite doctrine be true, labour under a gross and constant delusion. The fact, however, unquestionably is, that the convictions of the meanest peasant, when he is enabled perfectly to comprehend the just statement of the subject, will oblige him to decide in favour of necessity. If interrogated, whether, instead of going to his daily labour on a particular occasion, he could have continued at home? he will reply, that most certainly he could, if he had so pleased, alluding merely to practical liberty or freedom from external controul. But when asked, whether he could have remained at home with the same inducements of duty and inclination to go abroad? as soon as he fully understands the question, he will answer, that he certainly could not without changing his mind; in other words, that without some alteration in his feelings of inclination and duty, some variation in mature cause or preceding circumstances, whatever term we choose to adopt, he must inevitably have proceeded to his work.

Philosophical necessity is the only theory consistent with moral discipline. An intelligent agent is the proper subject of approbation or censure, of reward or punishment, only so far as he is determined in definite circumstances to definite volitions. If he perform a virtuous action from a pure motive, he is entitled to the approval and praise of all observers, and the remuneration which thus flows to him from general esteem, and also from the consciousness of benevolent dispositions, from the view of successful efforts, and the hope of future final reward, operates to confirm the disposition from which the act proceeded, to establish a habit, and fix a character of pure beneficence in the agent, and to excite in beings similarly constituted the adoption of the same means for the attainment of the same satisfaction.

With respect likewise to censure and punishment, these are, with equal propriety, applied to every intelligent being, who, actuated by malignant motives, defames innocence, or oppresses penury, or commits any act tending to the production of mischief and misery. The application of popular blame or reproach, and the pain arising from a sense of impaired estimation, from the apprehension of private vengeance or legal conviction, or any of those numberless modes of torture, which haunt and convulse the soul of guilt, are obviously calculated to produce a change of character and conduct, to excite first thoughtfulness, and subsequently reformation, in the mind of the offender, and to kindle a beacon, by which those within observation will be influenced to shun a road, which inevitably terminates in suffering and infamy. If any being can be supposed perfectly indifferent and independent with respect to motives, the application of all these moral means is obviously and absolutely superseded. The door is effectually closed to discipline. To attempt to operate on such a being by remonstrance or approval, by the erection of a statue, or the infliction of the torture, would be just as absurd as to thank the genial shower, or lash the tempestuous ocean; to applaud the soil for its fertility, or denounce the earthquake for its ravages.

The doctrine of necessity, moreover, tends to inspire that moral caution, which is of the utmost importance towards the formation of habitual virtue. Those who rely on some indefinable self-determining power, by which they presume themselves able to act without a motive, where motives are equal, or in opposition to the strongest motive, may expose themselves to circumstances and situations, in which they have before yielded to temptation without inconsistency, though certainly not without danger. The necessitarian is well aware that the same situations will ever produce the same results; that, whatever be the firmness of habit, there exist temptations, by which the most stable and accomplished virtue may be endangered and impaired. He will therefore sedulously avoid all unnecessary exposure, and will be particularly guarded against circumstances in which his good resolutions have already failed. For though it may be impossible for him, in a second instance, to be in a situation precisely similar to that by which he was overpowered in the first, the recollection and regret of his defeat making unquestionably some variation, this difference will by no means preclude that strong and striking similarity, which must sound in his ear the trumpet of alarm, and prevent his again approaching the verge of a gulph, into which he has been once miserably precipitated.

It must further be observed, that the doctrine of the necessity of human actions tends strongly to excite and cherish the benevolent affections. It represents human agents as merely instrumental to the views and schemes of Deity, under whose hands all intelligent creatures resemble the toys upon the chequered table, directed to his purpose, and impelled by his energy. A consideration this, admirably calculated to substitute compassion for resentment, to check the thirst of vengeance, and the severity of punishment. The propriety indeed and indispensableness of exhibiting to the mind motives or applications of a painful character, are admitted to be more clearly perceivable upon this system than on any other; and in truth are, only upon this system, perceivable at all. Authority must rebuke, law must menace, tribunals must sentence.

The accomplishment of individual reformation, and the prevention of public corruption, must be attempted by the means best adapted to these objects, and these means, from the constitution of human nature, include a certain portion of physical evil; but this is admitted, on the doctrine of necessity, only as remedial, or preventive of greater evil. Punishment, upon this system, proceeds not from revenge, but from benevolence. The offender is considered as having been urged to the act of guilt by circumstances controlling his will with the most rigid and irresistible dominion; as impelled not more by voluntary determination than by necessitating motive. He is considered as requiring, indeed, inflictions of a description highly impressive and penal, to enable him to break the bands of vicious habits; but the indispensableness of these inflictions is perceived with extreme regret, and yielded to with extreme reluctance. The persecutor is even more compassionated than his victim, and the tear of pity accompanies the lash of punishment.

It has been urged, that the doctrine of necessity tends to discourage exertion as useless, and to produce a total stagnation and torpor of the soul, since every thought and act of every individual being determined by necessary influences, and regulated by eternal laws, these can no more be counteracted by him, than he can pluck the moon from her orbit, or comprehend the ocean in a span. Whatever be the pressure of this difficulty, it is by no means peculiar to the doctrine in question, but applies with equal force to all who maintain the prescience of the Supreme Being, and who are, in fact, nearly all that do not deny his existence.

Foreknowledge unquestionably includes the certainty of those events which are foreknown; yet the advocates of liberty and prescience by no means regard this absolute certainty as precluding the employment of means. But necessity is merely another word for certainty, and the remonstrances and exhortations, the deliberations and efforts, which are admitted to be usefully instrumental with respect to events decidedly foreknown, must be allowed equally applicable with regard to such as are fixed by the eternal series of necessary causation and production. The events in both cases are equally certain, and, on that account merely, equally inevitable, and equally necessitated. In reality, whatever be the certainty or necessity of future events, the ignorance of man respecting them will always operate upon him as if they were actually uncertain or contingent. The conviction felt by every one, that the period and circumstances of his dissolution are perfectly known to God, and consequently unalterable by prayers or efforts, does not diminish his exertions for the preservation of his life; and the farmer cultivates his ground with equal attention and assiduity, though he knows it is clearly foreseen by God, whether the reaper shall gather a crop of grain or mildew. If ends are certain and necessary, so likewise are means. Those who neglect the latter are precluded from the former. The seed deposited in the ground may not always mature into the golden harvest; but unless the seed be deposited, no harvest whatever can appear. The regular application of food and air will not always preserve the human frame in vitality and vigour; but without air and food, its strength and life must inevitably perish.

Voluntary action is an essential link in the chain of causes. The whole course of moral nature ascertains its necessity to the accomplishment of various objects of human wishes, and the man, who, possessing ardent desires for any particular object, declines the employment of those efforts, without which it must be miraculous or impossible that he should obtain it, must be considered as exhibiting an instance of something worse than absurd reasoning, in proportion as madness is more pitiable than absurdity.

Finally, upon the principles of necessity, God is undoubtedly the author of evil: a statement, which, to the minds of some, may carry the appearance of the most irreverent, and even impious imputation, and excite against the system, which not only thus maintains, but avows it, a repulsion amounting to antipathy. The question, however, relates to truth, and not to feeling, and those who pursue the former, with that ardent attachment and eager research which it merits, will endeavour to divest themselves as much as possible of prejudice and prepossession, and strive to attain that point of elevation to which the fogs of passion never ascend, and at which the mental eye can range at once with clearness and comprehension. Every act and volition of intelligent creatures is the immediate effect of necessitating circumstances, originating in other circumstances equally necessitated, and which, through a long series of operation and result, must be considered as depending on that situation, into which, independently of their own consent or controul, they were at first introduced by their Creator. Every reflection, determination and deed, therefore, however tainted by vice, or exalted by virtue, must indisputably, upon this statement, flow from the divine appointment and energy. But to those who admit the prescience of the Deity, who do not, in order to support an hypothesis, proceed so far as to divest the Supreme Being of that foreknowledge of events, without which confusion and disappointment must apparently result to the divine mind, from occurrences neither appointed nor expected, the difficulty under consideration is precisely the same. All such must admit that he, who sees the end from the beginning, placed all human beings originally in situations, the most minute results of which were fully comprehended and foreknown by him. Notwithstanding his precise comprehension of all the consequences which must flow from their origination in such circumstances, in such circumstances they were actually placed, and foreseeing that natural and moral evil would be the certain effects of his own voluntary act in man's creation, he must not only have permitted, but designed, these effects. The prescience of a mere observer would by no means necessarily imply any intention that the event foreseen should be accomplished, or any thing more indeed than the absolute certainty of the event itself. But the prescience possessed by an agent of all the circumstances that will arise from any particular act, inevitably includes, in his purpose to accomplish that act, a purpose to produce these circumstances, and renders him as much the author of the inevitable consequences as of the previous act; and if evil therefore were foreknown to be the necessary result of man's formation, the existence of evil, and the formation of man, are equally attributable to the divine appointment.

But it is time to observe, that when God is stated to be the author of evil, it is by no means meant to be understood that he approves of it in itself, that he is pleased with the infliction of pain, and like an omnipotent dæmon delights in scattering darts and firebrands, terror and agony, through a trembling and prostrate universe. The meaning is, that in the system of creation most worthy of the perfections of the Deity, because eventually most conducive to the happiness of his offspring, some portion of natural and moral evil was absolutely unavoidable, and that his object is to combine, as much as possible, the least evil with the greatest good. In the accomplishment of this sublime object, particular beings may be exposed to a very considerable share of suffering; but this is no imputation upon his justice or benevolence. He possesses a sovereign right over the creatures he has formed, and the utmost demand that can be made by any beings upon his equity is, that in the amount of their existence misery should not predominate over happiness. But, whatever may be the case with certain individuals, there is reason to presume and believe, that with respect to the intelligent and moral creation as a whole, suffering will at length nearly disappear in the grand mass and display of enjoyment. That union of wisdom, power, and goodness, which it appears inevitable to ascribe to God, seems to guarantee an issue of his schemes and government, thus honourable to his nature, and thus happy for his offspring. With resignation, therefore, and even transport, we may contemplate this glorious Being, sitting at the helm of the universe, managing all affairs, and administering the whole series of events, guiding all to his magnificent purposes, guided himself by consummate knowledge and inexhaustible kindness, impelling every act, reflection and feeling of his intelligent creation, himself impelled by his own boundless views and eternal benevolence. For the arguments on the other side of the question, *viz.* the "Liberty of the Will," see WILL, *liberty of.*

NECK, is that slender part situated between the head and the trunk of the body. See ANATOMY.

NECTARINE. See PERSICA.

NECTARIUM, in botany, according to Linnæus, is a part of the corolla, appropriated for containing honey that oozes from the plant, and is the principal food of bees and other insects.

NECTRIS, in botany, a genus of the Hexandria Digynia class and order. Natural order of Tripetaloideæ. Junci, Jussieu. Essential character: calyx one-leafed, six-parted, coloured; corolla none; styles permanent; capsules two, superior, ovate, one-celled, many-seeded. There is but one species, *viz.* N. aquatica. This plant grows in ponds, lakes, and rivers, that have not a rapid current, pushing out long, knotted, fistulous stems, with a pair of leaves at each joint. The flowers come out from the axils of the leaves, on a long peduncle; the three outer leaves of the calyx are green on the outside and yellow within. It is a native of Guiana and the island of Cayenne.

NECYDALIS, in natural history, a genus of insects of the order of Coleoptera. Antennæ, setaceous or filiform; four feelers, filiform; shells less than the wings, and either narrower or shorter than the abdomen; tail simple. There are about forty species, in two sections. A. Antennæ setaceous; shells shorter than the wings and abdomen. B. Antennæ filiform; shells subulate, as long as the body. N. humeralis is found in England: shells subulate, black, yellow at the base, without lines; body and legs black.

NE *exeat Regno*, is a writ to restrain a person from going out of the kingdom without the King's licence. Within the realm the King may command the attendance and service of all his liegemen; but he cannot send any man out of the realm, not even upon the public service, except seamen and soldiers, the nature of whose employment necessarily implies an exception. This writ is now mostly used where a suit is commenced in the Court of Chancery against a man, and he, intending to defeat the other of his just demand, or to avoid the justice and equity of the court, is about to go beyond sea. If the writ be granted on behalf of a subject, and the party taken, he either gives security by bond in such sum as is demanded, or he satisfies the court by answering (where the answer is not already in,) or by affidavit, that he intends not to go out of the realm, and gives such reasonable security, as the court directs, and then he is discharged.

NEEDLE, a very common little instrument or utensil, made of steel, pointed at one end, and pierced at the other, used in sewing, embroidery, tapestry, &c.

Needles make a very considerable article in commerce, though there is scarcely any commodity cheaper, the consumption of them being almost incredible. The sizes are from number 1, the largest, to number 25, the smallest. In the manufacture of needles, German and Hungarian steel are of most repute. In the making them, the first thing is to pass the steel through a coal fire, and under a hammer, to bring it out of its square figure into a cylindrical one. This done, it is drawn through a second hole of a wire-drawing-iron, and returned into the fire, and drawn through a second hole of the iron, smaller than the first, and thus successively, from hole to hole, till it has acquired the degree of fineness required for that species of needles, observing every time it is to be drawn that it be greased over with lard, to render it more manageable. The steel thus reduced to a fine wire, is cut in pieces of the length of the needles intended. These pieces are flatted at one end on the anvil, in order to form the head and eye: they are then put into the fire to soften them further, and thence taken out and pierced at each extreme of the flat part, on the anvil, by force of a puncheon of well-tempered steel, and laid on a leaden block, to bring out, with another puncheon, the little piece of steel remaining in the eye. The corners are then filed off the square of the heads, and a little cavity filed on each side of the flat of the head; this done, the point is formed with a file, and the whole filed over: they are then laid to heat red hot on a long flat narrow iron, crooked at one end, in a charcoal fire, and when taken out hence, are thrown into a basin of cold water to harden. On this operation a good deal depends: too much heat burns them, and too little leaves them soft: the medium is learned by experience. When they are thus hardened, they are laid in an iron shovel on a fire, more or less brisk in proportion to the thickness of the needles; taking care to move them from time to time. This serves to temper them, and take off their brittleness: great care here too must be taken of the degree of heat. They are then straightened one after another with the hammer, the coldness of the water used in hardening them having twisted the greatest part of them. The next process is the polishing them. To do this they take twelve or fifteen thousand needles, and range them in little heaps against each other, on a piece of new buckram sprinkled with emery-dust. The needles thus disposed, emery-dust is thrown over them, which is again sprinkled with oil of olives; at last the whole is made up into a roll, well bound at both ends. This roll is then laid on a polishing-table, and over it a thick plank loaden with stone, which two men work backwards and forwards a day and a half, or two days, successively; by which means, the roll thus continually agitated by the weight and motion of the plank over it, the needles withinside being rubbed against each other with oil and emery, are insensibly polished. After polishing they are taken out, and the filth washed off them with hot water and soap: they are then wiped in hot bran, a little moistened, placed with the needles in a round box, suspended in the air by a cord, which is kept stirring till the bran and needles be dry. The needles, thus wiped in two or three different brans, are taken out and put in wooden vessels, to have the good separated from those whose points or eyes have been broke either in polishing or wiping: the points are then all turned the same way, and smoothed with an emery stone turned with a wheel. This operation finishes them, and there remains nothing but to make them into packets of two hundred and fifty each.

Needle, *magnetical*, in navigation, a needle touched with a loadstone, and sustained on a pivot or centre; on which, playing at liberty, it directs itself to certain points in or under the horizon; whence the magnetical needle is of two kinds, *viz.* horizontal and inclinatory.

Horizontal needles are those equally balanced on each side the pivot that sustains them; and which, playing horizontally with their two extremes, point out the north and south points of the horizon.

In the construction of the horizontal needle a piece of pure steel is provided, of a length not exceeding six inches, lest its weight impede its volubility, very thin, to take its verticity the better, and not pierced with any holes, or the like, for ornament sake, which prevent the equable diffusion of the magnetic virtue. A perforation is then made in the middle of its length, and a brass cap or head soldered on, whose inner cavity is conical, so as to play freely on a style or pivot headed with a fine steel point. The north point of the needle in our hemisphere is made a little lighter than the southern; the touch always destroying the balance, if well adjusted before, and rendering the north end heavier than the south, and thus occasioning the needle to dip.

The needle is not found to point precisely to the north, except in very few places, but deviates from it more or less in different places, and that too at different times, which deviation is called its declination or variation from the meridian.

Inclinatory or dipping-needle, a magnetical needle, so hung, as that, instead of playing horizontally and pointing out north and south, one end dips or inclines to the horizon, and the other points to a certain degree of elevation above it. Or a dipping-needle may be defined to be a long straight piece of steel, every way poised on its centre, and afterwards touched with a loadstone, but so contrived as not to play on the point of a pin, as does the common horizontal needle, but to swing in a vertical plane, about an axis parallel to the horizon; and this to discover the exact tendency of the power of magnetism. See Magnetism.

To find the longitude or latitude by the dipping-needle. If the lines of equal dip below the horizon be drawn on maps or sea charts from good observations, it will be easy, from the longitude known, to find the latitude, and from the latitude known, to find the longitude, either at sea or land. Suppose, for example, you were travelling or sailing along the meridian of London, and found the angle of dip with a needle of one foot to be 75°, the chart will show that this meridian and the line of dip meet in the latitude 53° 11′, which is therefore, the latitude sought. See Latitude. Or suppose you were travelling or sailing along the parallel of London, that is, in 51° 32′ north latitude, and you find the angle of dip to be 74°. The parallel and the line of this dip will meet in the map in 1° 46′, of east longitude from London, which is therefore the longitude sought.

Needle *stone*, in mineralogy, a species of the Zeolite family, found in Iceland and Britanny Its common colour is a yellowish white. It occurs massive, and crystallized in rectangular four-sided acicular prisms, which are generally aggregated. It is distinguished from the radiated zeolite, by being harder and more brittle, by its lustre being greater, and of the vitreous kind.

NEGATIVE, in general, something that implies a negation. Thus we say, negative quantities, negative signs, negative powers, &c. See Algebra.

Our words and our ideas, says Dr. Watts, are so unhappily linked together, that we can never know which are positive, which negative ideas, by the words that express them: for some positive terms denote a negative idea, as *dead*: and there are both positive and negative terms invented to signify the same and contrary ideas, as *unhappy* or *miserable*. To this may also be added, that some words, which are negative in the original language, seem positive in English, as *abyss*. The way, therefore, to know whether any idea be negative or not, is to consider whether it primarily implies the absence of any positive being, or mode of being: if so, then it is a negative idea, otherwise a positive one.

Negative *sign*, the sign of subtraction, or that which denotes something in defect. The use of the negative sign in algebra is attended with several consequences that at first sight are admitted with some difficulty, and has sometimes given occasion to notions that seem to have no real foundation. This sign implies, that the real value of the quantity represented by the letter to which it is prefixed is to be subtracted; and it serves, with the positive sign, to keep in view what elements or parts enter into the composition of quantities, and in what manner, whether as increments or decrements, that is, whether by addition or subtraction, which is of the greatest use in this art. Hence it serves to express a quantity of an opposite quality to a positive, such as a line in a contrary position, a motion with opposite direction, or a centrifugal force in opposition to gravity; and thus it often saves the trouble of distinguishing, and demonstrating separately, the various cases of proportions, and preserves their analogy in view. But as the proportions of lines depend on their magnitude only, without regard to their position; and motions and forces are said to be equal or unequal, in any given ratio, without regard to their directions; and in general the proportion of quantities relates to their magnitude only, without determining whether they are to be considered as increments or decrements; so there is no ground to imagine any other proportion of + *a* and — *b*, than that of the real magnitude of the quantities represented by *a* and *b*, whether these quantities are, in any particular case, to be added or subtracted.

NEGRO, a name given to a variety of the human species, who are entirely black, and are found in the torrid zone, especially in that part of Africa which lies between the tropics. See MAN; SLAVE; SLAVE *trade*.

NEPA, in natural history, *water-scorpion*, a genus of insects of the order Hemiptera. Snout inflected; antennæ short; wings four, folding crosswise, coriaceous on the upper part; fore legs cheliform; the other four formed for walking. There are fourteen species, in three divisions, *viz.* A. Antennæ palmate, without a lip, B. Antennæ palmate; lip short, widely emarginate. C. Lip projecting, rounded. N. linearis, described by Mr. Donovan, has a tail ending in two bristles, as long as the body; thorax of one colour; foreshanks with a spine in the middle. The body is brown, cylindrical; abdomen red; the eggs are oblong, and armed at one end with two bristles, and are found inclosed in the culm or stem of rushes, with hairs standing out.

NEPENTHES, in botany, a genus of the Dioecia Syngenesia class and order. Essential character: calyx four-parted; corolla none: male, filament one, with many anthers, connected into a peltate head: female, style none; stigma large; peltate four-lobed; capsule four-celled, with many arilled seeds. There is but one species, *viz.* N. distillatoria, a native of the island of Ceylon.

The nepenthes may justly be classed among the most singular productions of the vegetable world. The plant has always excited the admiration of those who have examined its structure, with a view to the contrivance which is so strikingly exhibited in the formation of its leaves. The nepenthes is a native of India; it is an herbaceous plant, with thick roots and a simple stem, crowned with flowers disposed in bunches. The leaves are alternate, partly embracing the stem at their base, and terminated by tendrils, each of which supports a deep, membranous urn, of an oblong shape, and closed by a little valve like the lid of a box. This appendage to the leaf appears to be as designed and studied a piece of mechanism as any thing we can meet with in nature's more complicated productions. The leaf, as we have already said, is terminated by a deep oblong urn; this, in general, is filled with a sweet limpid water. In the morning the lid is closed, but it opens during the heat of the day, and a portion of the water evaporates; this is replenished in the night, and each morning the vessel is full, and the lid shut. The plant grows in a climate where the parched traveller is frequently in want of refreshment, and gladly avails himself of the water which this vegetable affords, each urn containing about the measure of half a wine glass. The use of this plant is too evident to need any comment. It is one of the many instances in nature of the bounty of Providence, who has filled the urns of the nepenthes with a treasure, of all others the most refreshing to the inhabitants of hot climates.

NEPER, or NAPIER (JOHN), in biography, Baron of Marchiston, in Scotland, inventor of the logarithms, was the eldest son of Sir Archibald Napier, of Marchiston, and born in the year 1550. Having given early indications of great natural parts, his father was careful to have them cultivated by a liberal education. After going through the ordinary course of education at the university of St. Andrew's, he made the tour of France, Italy, and Germany. On his return to his native country, his literature and other fine accomplishments soon rendered him conspicuous; he, however, retired from the world, to pursue literary researches, in which he made an uncommon progress, as appears by the several useful discoveries with which he afterwards favoured mankind. He chiefly applied himself to the study of mathematics, without, however, neglecting that of the Scriptures; in both of which he discovered a very extensive knowledge, and profound penetration. His "Essay upon the Book of the Apocalypse" indicates the most acute investigation; though time has discovered, that his calculations concerning particular events had proceeded from fallacious data. But what has chiefly rendered his name famous was his great and fortunate discovery of logarithms in trigonometry, by which the ease and expedition in calculation have so wonderfully assisted the science of astronomy, and the arts of practical geometry and navigation. Napier, having a great attachment to astronomy and spherical trigonometry, had occasion to make many numeral calculations of such triangles, with sines, tangents, &c.; and these being expressed in large numbers, they hence occasioned a great deal of labour and trouble: to spare themselves part of this trouble, Napier, and other authors about his time, set themselves to find out certain short modes of calculation, as is evident from many of their writings. To this necessity and these endeavours it is, that we owe several ingenious contrivances, particularly the computation by Napier's rods, and several other curious and short methods that are given in his "Rabdologia;" and, at length, after trials of many other means, the most complete one of logarithms, in the actual construction of a large table of numbers in arithmetical progression, adapted to a set of as many others in geometrical progression. The property of such numbers had been long known, *viz.* that the addition of the former answered to the multiplication of the latter, &c.; but it wanted the necessity of such very troublesome calculations as those above mentioned, joined to an ardent disposition, to realize the use of that property. Perhaps, also, this disposition was urged into action by certain attempts of this kind, which, it seems, were made elsewhere; such as the following, related by Wood, in his "Athenæ Oxonienses," under the article Briggs, on the authority of Oughtred and Wingate, *viz.* "That one Dr. Craig, a Scotchman, coming out of Denmark into his own country, called upon John Neper, baron of Marchiston, near Edinburgh, and told him, among other discourses, of a new invention in Denmark, (by Longomontanus, as 'tis said) to save the tedious multiplication and division in astronomical calculations. Neper, being solicitous to know further of him concerning this matter, he could give no other account of it, than that it was by proportionable numbers; which hint Neper taking, he desired him, at his return, to call upon him again: Craig, after some weeks had passed, did so, and Neper then showed him a rude draught of that he called Canon Mirabilis Logarithmorum; which draught, with some alterations, he printed in 1614; it came forthwith into the hands of our author, Briggs, and into those of William Oughtred, from whom the relation of this matter came."

Whatever might be the inducement, however, Napier published his invention in 1614, under the title of "Logarithmorum Canonis Descriptio," &c. containing the construction and canon of his logarithms, which are those of the kind that is called hyperbolic. This work coming presently to the hands of Mr. Briggs, then Professor of Geometry at Gresham College, in London, he immediately gave it the greatest encouragement, teaching the nature of the logarithms in his public lectures, and at the same time recommending a change in the scale of them, by which they might be advantageously altered to the kind which he afterwards computed himself, which are thence called Briggs' logarithms, and are those now in common use. Mr. Briggs also presently wrote to Lord Napier upon this proposed change, and made journeys to Scotland the two following years, to visit Napier, and consult him about that alteration, before he set about making it. Briggs, in a letter to Archbishop Usher, March 10th, 1615, writes thus: "Napier, Lord of Marchiston, hath set my head and hands at work with his new and admirable logarithms. I hope to see him this summer, if it please God; for I never saw a book which pleased me better, and made me more wonder." Briggs accordingly made him the visit, and staid a month with him.

The following passage from the life of Lilly, the astrologer, contains a curious account of the meeting of those two illustrious men. "I will acquaint you (says Lilly) with one memorable story, related unto me by John Marr, an excellent mathematician and geometrician, whom I conceive you remember. He was servant to King James and Charles I. At first, when the Lord Napier, or Merchiston, made public his logarithms, Mr. Briggs, then reader of the astronomy lectures at Gresham College, in London, was so surprised with admiration of them, that he could have no quietness in himself, until he had seen that noble person, the Lord Merchiston, whose only invention they were: he acquaints John Marr herewith, who went into Scotland before Mr. Briggs, purposely to be there when these two so learned persons should meet. Mr. Briggs appointed a certain day when to meet at Edinburgh; but failing thereof, the Lord Napier was doubtful he would not come. It happened one day, as John Marr and the Lord Napier were speaking of Mr. Briggs; 'Ah, John, (said Merchiston) Mr. Briggs will not now come.' At the very instant one knocks at the gate; John Marr hastened down, and it proved John Briggs, to his great contentment. He brings Mr. Briggs up into my Lord's chamber, where almost one quarter of an hour was spent, each beholding the other almost with admiration before one word was spoke. At last Mr. Briggs began: 'My Lord, I have undertaken this long journey purposely to see your person, and to know by what engine of wit or ingenuity you came first to think of this most excellent help into astronomy, *viz.* the logarithms; but, my Lord, being by you found out, I wonder nobody else found it out before, when now known it is so easy.' He was nobly entertained by the Lord Napier; and every summer after that, during the Lord's being alive, this venerable man, Mr. Briggs, went purposely into Scotland to visit him."

Napier made also considerable improvements in spherical trigonometry, &c. particularly by his "Catholic, or Universal Rule," being a general theorem by which he resolves all the cases of right-angled spherical triangles in a manner very simple, and easily to be remembered; namely, by what he calls the five circular parts. His construction of logarithms too, beside the labour of them, manifests the greatest ingenuity. Kepler dedicated his "Ephemerides" to Napier, which were published in the year 1617; and it appears from many passages in his letter, about this time, that he accounted Napier to be the greatest man of his age, in the particular department to which he applied his abilities.

The last literary exertion of this eminent person, was the publication of his "Rabdology and Promptuary," in the year 1617, soon after which he died at Merchiston, the 3d of April, in the same year, in the sixty-eighth year of his age. The list of his works is as follows:

1. A Plain Discovery of the Revelation of St. John; 1593.
2. Logarithmorum Canonis Descriptio; 1614.
3. Mirifici Logarithmorum Canonis Constructio; et eorum ad Naturales ipsorum numeros habitudines; una cum appendice, de alia eaque præstantiore Logarithmorum speciæ, condenda. Quibus accessere propositiones ad triangula sphærica faciliore calculo resolvenda. Una cum Annotationibus aliquot doctissimi D. Henrici Briggii in eas, et memoratam appendicem. Published by the Author's son, 1619.
4. Rabdologia, seu Numerationis per Virgulas, libri duo; 1617. This contains the description and use of the bones or rods; with several other short and ingenious modes of calculation.
5. His Letter to Anthony Bacon, (the original of which is in the Archbishop's Library at Lambeth), entitled Secret Inventions, profitable and necessary in these days for the defence of this island, and withstanding strangers, enemies to God's truth and religion; dated June 2, 1596.

NEPER'S *rods*, or *bones*, an instrument invented by the above-named person, whereby the multiplication and division of large numbers are much facilitated.

As to the Construction of Neper's Rods: suppose the common table of multiplication to be made upon a plate of metal, ivory or paste-board, and then conceive the several columns (standing downwards from the digits on the head) to be cut asunder; and these are what we call Neper's rods for multiplication. But then there must be a good number of each; for as many times as any figure is in the multiplicand, so many rods of that species (*i. e.* with that figure on the top of it) must we have; though six rods of each species will be sufficient for any example in common affairs: there must also be as many rods of 0's.

But, before we explain the way of using these rods, there is another thing to be known, *viz.* that the figures on every rod are written in an order different from that in the table. Thus, the little square space, or division, in which the several products of every column are written, is divided into two parts, by a line across from the upper angle on the right to the lower on the left; and if the product is a digit, it is set in the lower division; if it has two places, the first is set in the lower, and the second in the upper division; but the spaces on the top are not divided; also there is a rod of digits not divided, which is called the index-rod, and of this we need but one single rod.

Multiplication by Neper's Rods. First lay down the index-rod; then on the right of it set a rod, whose top is the figure in the highest place of the multiplicand: next to this, again, set the rod whose top is the next figure of the multiplicand; and so on in order, to the first figure. Then is your multiplicand tabulated for all the nine digits; for in the same line of squares standing against every figure of the index-rod, you have the product of that figure, and therefore you have no more to do but to transfer the products and sum them. But in taking out these products from the rods, the order in which the figures stand obliges you to a very easy and small addition: thus, begin to take out the figure in the lower part, or unit's place, of the square of the first rod on the right: add the figure in the upper part of this rod to that in the lower part of the next, and so on, which may be done as fast as you can look on them. To make this practice as clear as possible, take the following example.

Example. To multiply 4,768 by 185.

Having set the rods together for the number 4,768 against 5 in the index, I find this number, by adding according to

the rule	23,840
Against 8, this number . . .	38,144
Against 3, this number . .	14,304
Total product	1,835,680

To make the use of the rods yet more regular and easy, they are kept in a flat square box, whose breadth is that of ten rods, and the length that of one rod, as thick as to hold six (or as many as you please) the capacity of the box being divided into ten cells, for the different species of rods. When the rods are put up in the box, (each species in its own cell, distinguished by the first figure of the rod set before it on the face of the box near the top) as much of every rod stands without the box, as shews the first figure of that rod; also upon one of the flat sides without and near the edge, upon the left hand, the index-rod is fixed: and along the foot there is a small ledge, so that the rods, when applied, are laid upon this side, and supported by the ledge, which makes the practice very easy; but in case the multiplicand should have more than nine places, that upper face of the box may be made broader. Some make the rods with four different faces, and figures on each for different purposes.

Division by Neper's Rods. First tabulate your divisor; then you have it multiplied by all the digits, out of which you may choose such convenient divisors as will be next less to the figures in the dividend, and write the index answering in the quotient, and so continually, till the work is done. Thus 2,179,788, divided by 6,123, gives in the quotient 356.

Having tabulated the divisor, 6,123, you see that 6,123 cannot be had in 2,179; therefore take five places, and on the rods find a number that is equal, or next less to 21,797, which is 18,369; that is, three times the divisor, wherefore set 3 in the quotient, and subtract 18,369 from the figures above, and there will remain 3,428; to which add 8, the next figure of the dividend, and seek again on the rods for it, or the next less, which you will find to be five times; therefore set 5 in the quotient, and subtract 30,615 from 34,228, and there will remain 3,673, to which add 8, the last figure in the dividend, and finding it to be just six times the divisor, set 6 in the quotient.

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NEPETA, in botany, *catmint*, a genus of the Didynamia Gymnospermia class and order. Natural order of Verticillatæ. Labiatæ, Jussieu. Essential character: corolla, lower lip with an intermediate segment, crenate; throat reflex at the edge; stamina approximating. There are twenty species, among which is the N. cataria, common catmint; it has a perennial root, and many branching stalks, about two feet in height, upright, pubescent; leaves of a velvet-like softness, wrinkled, ash-coloured: spikes, composed of interrupted whorls, terminate the stem; flowers sub-sessile: calyx downy, with green ribs; corolla white; the whole plant has a strong scent, between mint and pennyroyal; it is called catmint, because cats are very fond of it, especially when it is withered, when they will roll themselves on it, tear it to pieces, and chew it with pleasure. It is a native of most parts of Europe, on banks and hedges, chiefly in a calcareous soil, flowering from July to September.

NEPHELIUM, in botany, a genus of the Monoecia Pentandria class and order. Natural order of Tricoccæ. Corymbiferæ, Jussieu. Essential character: male, calyx five-toothed; corolla none: female, calyx four-cleft; corolla none; germs two, with two styles to each; drupes two, muricated one-seeded. There is but one species, *viz.* N. lappaceum, a native of the East Indies.

NEPHRITE, in mineralogy, a species of the Talc genus; it is also called *jade*, or *jade-stone*. It was formerly celebrated for its medical virtues. It is of a dark leek-green colour, verging to blue. It occurs massive, in detached rounded pieces. The smooth external surface is glimmering, with an oily lustre; internally it is dull, except when mixed with fibres of asbestos and scales talc. The specific gravity is about 3. There are about two sub-species: the common, and axe-stone: the former is somewhat brittle, takes a good polish, and is cut into handles for knives, &c.; the latter is made into hatchets by the natives of New Zealand. Nephrite is found in Egypt, China, America, the islands in the Pacific Ocean, and in the Siberian mountains, sometimes adhering to rocks, and sometimes in detached round pieces. It is highly prized by the Hindoos and Chinese, by whom it is made into talismans and idols, and by the Turks, who form it into sword and dagger handles.

NEPHRITIC, something that relates to the kidnies.

NEREIS, in natural history, a genus of the Vermes Mollusca class and order. Body long, creeping, with numerous lateral peduncles or feet on each side; feelers simple; two or four eyes. There are about thirty species, in separate divisions, *viz.* A. Mouth furnished with a claw or forceps. B. Mouth furnished with a proboscis. C. Mouth furnished with a tube. N. noctiluca, body blue-green, with twenty-three segments, hardly visible to the naked eye. These are found in most seas, and are the animals that frequently illuminate the water, making it appear as if on fire. They are extremely minute, pellucid, and highly phosphorous, giving an uncommonly lucid splendour to the waves in the evening. By their extreme numbers and smallness, they easily elude observation, but may be detected by passing a small quantity of water through blotting paper.

NERITA, in natural history, a genus of the Vermes Testacea class and order. Animal a limax; shell univalve, spiral, gibbous, flattish at bottom; aperture semi-orbicular or semi-lunar; pillar-lip transversely truncate, flattish. There are nearly eighty species, divided into distinct sections, *viz.* A. Umbilicate. B. Imperforate, with the lips toothless. C. Imperforate, with the lips toothed. N. fluviatilis, with only two spires; brittle, dusky, marked with white spots. It is not half the size of a pea, and inhabits rivers and standing waters of Europe.

NERIUM, in botany, *oleander*, a genus of the Pentandria Monogynia class and order. Natural order of Contortæ. Apocineæ, Jussieu. Essential character: contorted; corolla with the tube terminated by a lacerated crown; follicles two, erect. There are nine species: these are beautiful evergreen shrubs or trees, upright and branching; leaves opposite, or by threes, in a sort of whorl; flowers in clusters, or corymbs, from the ends of the stem and branches. They are chiefly natives of the East Indies.

NERTERIA, in botany, a genus of the Tetrandria Digynia class and order. Essential character: corolla funnel-form, four-cleft, superior; berry two-celled; seeds solitary. There is but one species, *viz.* N. depressa, found in New Granada.

NERVES, are cylindrical whitish parts, usually fibrose in their structure; or composed of clusters of filaments, arising from the brain, or rather from its medulla oblongata within the skull, and from the spinal marrow, and running from thence to every part of the body. See ANATOMY.

NET, a device for catching fish and fowl. The taking fowls by nets is the readiest and most advantageous of all others, where numbers are to be taken. The making the nets is very easy, and what every true sportsman ought to be able to do for himself. All the necessary tools are, wooden needles, of which there should be several of different sizes, some round and others flat: a pair of round-pointed and flat scissars, and a wheel to wind off the thread. The pack thread is to be of different strength and thickness, according to the sort of birds to be taken; and the general size of the meshes, if not for very small birds, is two inches from point to point. The nets should neither be made too deep nor too long, for they are then difficult to manage; and they must be verged on each side with twisted thread. The natural colour of the thread is too bright and pale, and is therefore in some cases to be altered. The most usual colour is the russet, which is to be obtained by plunging the net after it is made into a tanner's pit, and letting it lie there till it be sufficiently tinged; this is of a double service to the net, since it preserves the thread as well as alters the colour. The green colour is given by chopping some green wheat, and boiling it in water, and then soaking the net in this green tincture. The yellow colour is given in the same manner, with the decoction of celandine, which gives a pale straw colour, which is the colour of stubble in the harvest time. The brown nets are to be used on ploughed lands, the green on grass grounds, and the yellow on stubble lands.

NETTINGS, in a ship, a sort of grates made of small ropes, seized together with rope-yarn or twine, and fixed on the quarters and in the tops; they are sometimes stretched upon the ledges from the waist-trees to the roof-trees, from the top of the forecastle to the poop; and sometimes are laid in the waist of a ship, to serve instead of gratings.

NETTLE. See URTICA.

NEUMAN, (GASPAR, M. D.) in biography, an eminent chemist, was born in 1683, at Zullichau, in the dutchy of Crossen, in Brandenburg, of which place his father was a burgher and apothecary. He was brought up to his father's profession, and in 1705, went to Berlin, where he engaged in the service of the King of Prussia. After having accompanied him in his journeys for some years he was allowed to study at the university of Halle, and was then sent, at the King's expence, to travel for improvement in chemical knowledge. In 1711, he visited the German mines, and thence passed into Holland, where he attended the lectures of the illustrious Boerhaave. Thence he went to England, where the news of the death of his sovereign, in 1713, somewhat deranged his plans. He again visited Holland, and in 1716, accompanied George I. King of England, to Hanover. On repairing to Berlin, he obtained the friendship of Stahl, physician to Frederick-William, who procured an order for him to resume his travels at the expence of the court. He visited France and Italy, every where increasing his stock of scientific knowledge, and forming connections with men of eminence. Upon his return to Berlin he was appointed court-apothecary; and when the King, in 1723, established a college of medicine and surgery in his capital, Neuman was nominated to the chair of Chemistry. He received the degree of M. D. from Halle, in 1727, and in that year travelled through Silesia and Moravia, to Vienna, returning by Bohemia and the mining country of Saxony. His reputation now extended to the different countries of Europe, and he was elected a member of the Royal Society of London, of the Imperial Academy Naturæ Curiosorum, and of the Institute of Bologna. In 1734, he made the tour of the New Marche and Pomerania, where he discovered the true origin of Ostescolla. He became dean of the college of Berlin in 1736, and died in that city 1737. The works published by Dr. Neuman, in his lifetime, consist chiefly of dissertations in the Latin language, inserted in the "Philosophical Transactions of London," the "Ephemerides Acad. Naturæ Curiosorum," and the Miscellanea Berolinensia, and of others in the German language, published separately. After his death two different copies of his "Chemical Lectures" were given to the public: one, in two editions, at Berlin and Dresden, from notes taken by one of his pupils, intermixed with compilations from different authors; the other by the booksellers of the Orphan Hospital of Zullichau, from papers in Neuman's own hand-writing: of this there have been two impressions, the first in a large form, the second in an abridgment; which last, however, consists of two volumes, quarto. From this Dr. Lewis has made an excellent English translation in two volumes, octavo, still further abridged, but better methodized, and enriched with notes. "Neuman's Lectures," says Dr. Lewis, "are a valuable magazine of chemical knowledge. The author, biassed by no theory, and attached to no opinions, has enquired by experiment into the properties and uses of the most considerable natural and artificial productions, and the preparation of the principal commodities which depend on chemistry; and seems to have candidly, and without reserve, communicated all he discovered." Such a work must retain its value, notwithstanding the great modern changes in chemical theory.

NEURADA, in botany, a genus of the Decandria Decagynia class and order. Natural order of Succulentæ. Rosaceæ, Jussieu. Essential character: calyx five-parted; petals five; capsule inferior, ten-celled, ten-seeded, prickly. There is but one species; *viz.* N. procumbens, an annual plant; native of Egypt, Arabia, and Numidia.

NEUROPTERA, in natural history, the name of the fourth order of insects according to the Linnæan system, and so called on account of the nerves and veins disposed in their wings. The insects of this order have four wings: all of them membranaceous, reticulate: tail unarmed. There are seven genera, *viz.*

Ephemera
Hemerobius
Libellula
Myrmeleon
Panorpa
Phryganea
Raphidia
which see.

NEUTRAL *salts*. See next article; also SALTS.

NEUTRALIZATION, in chemistry, may be thus explained: if we take a given quantity of sulphuric acid diluted with water, and add it slowly to the solution of soda by little at a time, and examine the mixture after every addition, we shall find that for a considerable time it will exhibit the properties of an acid, reddening vegetable blues, and having a taste perceptibly sour: but these acid properties gradually diminish after every addition of the alkaline solution, and at last disappear altogether. If we still continue to add the soda, the mixture gradually acquires alkaline properties, converting vegetable blues to green, and manifesting an urinous taste. These properties become stronger and stronger, the greater the quantity of the soda is which is added. Thus it appears, that when sulphuric acid and soda are mixed together, the properties either of the one or the other preponderate, according to the proportions of each; but there are certrin proportions, according to which, when they are combined, they mutually destroy or disguise the properties of each other, so that neither predominates, or rather so that both disappear. When substances thus mutually disguise each other's properties, they are said to neutralize one another. This property is common to a great number of bodies; but it manifests itself most strongly, and was first observed in the acids, alkalies, and earths. Hence the salts which are combinations of these different bodies, received long ago the name of neutral salts.

NEWTON (SIR ISAAC), in biography, one of the greatest philosophers and mathematicians the world has produced, was born at Woolstrop, in Lincolnshire, on Christmas Day, 1642. He was descended from the eldest branch of the family of Sir John Newton, Bart. who were Lords of the manor of Woolstrop, and had been possessed of the estate for about two centuries before; to which they had removed from Westley, in the same county; but originally they came from the town of Newton, in Lancashire.

Other accounts say, probably with more truth, that he was the only child of Mr. John Newton, of Colesworth, near Grantham, in Lincolnshire, who had there an estate of about 120*l.* a year, which he kept in his own hands. His mother was of the ancient and opulent family of the Ayscoughs, or Askews of the same county. Our author losing his father while he was very young, the care of his education devolved on his mother, who, though she married again, did not neglect to improve by a liberal education the promising genius that was observed in her son. At twelve years of age, by the advice of his maternal uncle, he was sent to the grammar school at Grantham, where he made a good proficiency in the languages, and laid the foundation of his future studies. Even here was observed in him a strong inclination to figures and philosophical subjects. One trait of this early disposition is told of him: he had then a rude method of measuring the force of the wind blowing against him, by observing how much farther he could leap in the direction of the wind, or blowing on his back, than he could leap the contrary way, or opposed to the wind; an early mark of his original infantine genius.

After a few years spent here, his mother took him home; intending, as she had no other child, to have the pleasure of his company; and that, after the manner of his father before him, he should occupy his own estate.

But instead of attending to the markets, or the business of the farm, he was always studying and poring over his books, even by stealth from his mother's knowledge. On one of these occasions his uncle discovered him one day in a hay-loft at Grantham, whither he had been sent to the market, working a mathematical problem; and having otherwise observed the boy's mind to be uncommonly bent upon learning, he prevailed upon his sister to part with him; and he was accordingly sent, in 1660, to Trinity College, in Cambridge, where his uncle, having himself been a member of it, had still many friends. Isaac was soon taken notice of by Dr. Barrow, who was at this time appointed the first Lucasian professor of mathematics; and observing his bright genius, contracted a great friendship for him. At his commencement, Euclid was first put into his hands, as usual; but that author was soon dismissed, seeming to him too plain and easy, and unworthy of taking up his time. He understood him almost before he read him; and a cast of his eye upon the contents of his theorems, was sufficient to make him master of them: and as the analytical method of Des Cartes was then much in vogue; he particularly applied to it, and Kepler's optics, &c. making several improvements on them, which he entered upon the margins of the books as he went on, as his custom was in studying any author.

Thus he was employed till the year 1664, when he opened a way into his new method of Fluxions and Infinite Series; and the same year took the degree of Bachelor of Arts. In the mean time, observing that the mathematicians were much engaged in the business of improving telescopes, by grinding glasses into one of the figures made by the three sections of a cone, upon the principles then generally entertained, that light was homogeneous, he set himself to grinding of optic glasses, of other figures than spherical, having as yet no distrust of the homegeneous nature of light; but not hitting presently upon any thing in this attempt to satisfy his mind, he procured a glass prism, that he might try the celebrated phenomena of colours, discovered by Grimaldi not long before. He was much pleased at first with the vivid brightness of the colours produced by this experiment; but after a while, considering them in a philosophical way, with that circumspection which was natural to him, he was surprised to see them in an oblong form, which, according to the received rule of refractions, ought to be circular. At first he thought the irregularity might possibly be no more than accidental; but this was what he could not leave without further enquiry: accordingly, he soon invented an infallible method of deciding the question, and the result was his new Theory of Light and Colours.

However, the theory alone, unexpected and surprising as it was, did not satisfy him: he rather considered the proper use that might be made of it for improving telescopes, which was his first design. To this end, having now discovered that light was not homogeneous, but an heterogeneous mixture of differently refrangible rays, he computed the errors arising from this different refrangibility; and, finding them to exceed some hundreds of times those occasioned by the circular figure of the glasses, he threw aside his glass works, and began to consider the subject with precision. He was now sensible that optical instruments might be brought to any degree of perfection desired, in case there could be found a reflecting substance which could polish as finely as glass, and reflect as much light as glass transmits, and the art of giving it a parabolical figure he also attained; but these at first seemed to him very great difficulties; nay, he thought them almost insuperable, when he further considered, that every irregularity in a reflecting superficies makes the rays stray five or six times more from their due course, than the like irregularities in a refracting one.

Amidst these speculations, he was forced from Cambridge, in 1665, by the plague; and it was more than two years before he made any further progress in the subject. However, he was far from passing his time idly in the country; on the contrary, it was here, at this time, that he first started the hint that gave rise to the system of the world, which is the main subject of the Principia. In his retirement he was sitting alone in a garden, when some apples falling from a tree, led his thoughts upon the subject of gravity; and reflecting on the power of that principle, he began to consider, that, as this power is not found to be sensibly diminished at the remotest distance from the centre of the earth, to which we can rise, neither at the tops of the loftiest buildings, nor on the summits of the highest mountains, it appeared to him reasonable to conclude, that this power must extend much farther than is usually thought. "Why not as high as the moon?" said he to himself; "and if so, her motion must be influenced by it; perhaps she is retained in her orbit by it; however, though the power of gravity is not sensibly weakened in the little change of distance at which we can place ourselves from the centre of the earth, yet it is very possible that, at the height of the moon, this power may differ in strength much from what it is here." To make an estimate of what might be the degree of this diminution, he considered with himself, that if the moon be retained in her orbit by the force of gravity, no doubt the primary planets are carried about the sun by the like power; and by comparing the periods of the several planets with their distances from the sun, he found, that if any power like gravity held them in their courses, its strength must decrease in the duplicate proportion of the increase of distance. This he concluded by supposing them to move in perfect circles, concentric to the sun, from which the orbits of the greatest part of them do not much differ. Supposing, therefore, the force of gravity, when extended to the moon, to decrease in the same manner, he computed whether that force would be sufficient to keep the moon in her orbit.

In this computation, being absent from books, he took the common estimate in use among the geographers and our seamen, before Norwood had measured the earth, namely, that sixty miles make one degree of latitude; but as that is a very erroneous supposition, each degree containing about sixty-nine and one-third of our English miles, his computation upon it did not make the power of gravity, decreasing in a duplicate proportion to the distance, answerable to the power which retained the moon in her orbit; whence he concluded, that some other cause must at least join with the action of the power of gravity on the moon. For this reason he laid aside, for that time, any further thoughts upon the matter. Mr. Whiston (in his Memoirs, p. 33.) says, he told him that he thought Des Cartes's vortices might concur with the action of gravity.

Nor did he resume this enquiry on his return to Cambridge, which was shortly after. The truth is, his thoughts were now engaged upon his newly projected reflecting telescope, of which he made a small specimen with a metallic reflector spherically concave. It was but a rude essay, chiefly defective by the want of a good polish for the metal. This instrument is now in the possession of the Royal Society. In 1667, he was chosen fellow of his college, and took the degree of master of arts. And in 1669, Dr. Barrow resigned to him the mathematical chair at Cambridge, the business of which appointment interrupted, for a while, his attention to the telescope; however, as his thoughts had been for some time chiefly employed upon optics, he made his discoveries in that science the subject of his lectures for the first three years after he was appointed mathematical professor; and having now brought his theory of light and colours to a considerable degree of perfection, and having been elected a Fellow of the Royal Society, in January, 1672, he communicated it to that body, to have their judgment upon it; and it was afterwards published in their Transactions, *viz.* of February 19, 1672. This publication occasioned a dispute upon the truth of it, which gave him so much uneasiness, that he resolved not to publish any thing further for a while upon the subject; and in that resolution he laid by his optical lectures, although he had prepared them for the press. And the analysis by infinite series, which he had intended to subjoin to them, unhappily for the world, underwent the same fate, and for the same reason.

In this temper he resumed his telescope; and observing that there was no absolute necessity for the parabolic figure of the glasses, since, if metals could be ground truly spherical, they would be able to bear as great apertures as men could give a polish to, he completed another instrument of the same kind. This answering the purpose so well, as, though only half a foot in length, to show the planet Jupiter distinctly round, with his four satellites, and also Venus horned, he sent it to the Royal Society, at their request, together with a description of it, with further particulars; which were published in the Philosophical Transactions for March, 1672. Several attempts were also made by that society to bring it to perfection; but for want of a proper composition of metal, and a good polish, nothing succeeded, and the invention lay dormant till Hadley made his Newtonian telescope in 1723. At the request of Leibnitz, in 1676, he explained his invention of Infinite Series, and took notice how far he had improved it by his method of Fluxions, which, however, he still concealed, and particularly on this occasion, by a transposition of the letters that make up the two fundamental propositions of it, into an alphabetical order; the letters concerning which are inserted in Collins's "Commercium Epistolicum," printed 1712. In the winter, between the year 1676 and 1677, he found out the grand proposition, that by a centripetal force acting reciprocally as the square of the distance, a planet must revolve in an ellipsis, about the centre of force placed in its lower focus, and, by a radius drawn to that centre, describe areas proportional to the times. In 1680 he made several astronomical observations upon the comet that then appeared; which, for some considerable time, he took not to be one and the same, but two different comets; and upon this occasion several letters passed between him and Mr. Flamstead.

He was still under this mistake, when he received a letter from Dr. Hook, explaining the nature of the line described by a falling body, supposed to be moved circularly by the diurnal motion of the earth, and perpendicularly by the power of gravity. This letter put him upon enquiring anew what was the real figure in which such a body moved; and that enquiry convincing him of another mistake which he had before fallen into concerning that figure, put him upon resuming his former thoughts with regard to the moon; and Picart having not long before, *viz.* in 1679, measured a degree of the earth with sufficient accuracy, by using his measures, that planet appeared to be retained in her orbit by the sole power of gravity; and, consequently, that this power decreases in the duplicate ratio of the distance; as he had formerly conjectured. Upon this principle he found the line described by a falling body to be an ellipsis, having one focus in the centre of the earth. And finding by this means that the primary planets really moved in such orbits as Kepler had supposed, he had the satisfaction to see that this enquiry, which he had undertaken at first out of mere curiosity, could be applied to the greatest purposes. Hereupon he drew up about a dozen propositions, relating to the motion of the primary planets round the sun, which were communicated to the Royal Society in the latter end of 1683. This coming to be known to Dr. Halley, that gentleman, who had attempted the demonstration in vain, applied, in August, 1684, to Newton, who assured him that he had absolutely completed the proof. This was also registered in the books of the Royal Society; at whose earnest solicitation Newton finished the work, which was printed under the care of Dr. Halley, and came out about Midsummer, 1687, under the title of "Philosophiæ Naturalis Principia Mathematica," containing, in the third book, the cometic astronomy, which had been lately discovered by him, and now made its first appearance in the world: a work which may be looked upon as the production of a celestial intelligence rather than of a man.

This work, however, in which the great author has built a new system of natural philosophy, upon the most sublime geometry, did not meet at first with all the applause it deserved, and was one day to receive. Two reasons concurred in producing this effect: Des Cartes had then got full possession of the world. His philosophy was indeed the creature of a fine imagination, gaily dressed out: he had given her likewise some of nature's fine features, and painted the rest to a seeming likeness of her. On the other hand, Newton had, with an unparalleled penetration and force of genius, pursued nature up to her most secret abode, and was intent to demonstrate her residence to others, rather than anxious to describe particularly the way by which he arrived at it himself: he finished that piece in that elegant conciseness which had justly gained the ancients a universal esteem. In fact, the consequences flow with such rapidity from the principles, that the reader is often left to supply a long chain of reasoning to connect them, so that it required some time before the world could understand it. The best mathematicians were obliged to study it with care, before they could make themselves masters of it; and those of a lower rank durst not venture upon it, till encouraged by the testimonies of the more learned. But at last, when its value came to be sufficiently known, the approbation, which had been so slowly gained, became universal, and nothing was to be heard, from all quarters, but one general burst of admiration. "Does Mr. Newton eat, drink, or sleep, like other men?" says the Marquis De l'Hospital, one of the greatest mathematicians of the age, to the English who visited him. "I represent him to myself as a celestial genius, entirely disengaged from matter."

In the midst of these profound mathematical researches, just before his Principia went to the press in 1686, the privileges of the university being attacked by James the Second, Newton appeared among its most strenuous defenders, and was on that occasion appointed one of their delegates to the High-commission Court; and they made such a defence, that James thought proper to drop the affair. Our author was also chosen one of their members for the Convention Parliament, in 1688, in which he sat till it was dissolved.

Newton's merit was well known to Mr. Montague, then Chancellor of the Exchequer, and afterwards Earl of Halifax, who had been bred at the same college with him; and when he undertook the great work of recoining the money, he fixed his eye upon Newton for an assistant in it; and accordingly, in 1696, he was appointed Warden of the Mint, in which employment he rendered very signal service to the nation. And three years after he was promoted to be Master of the Mint, a place worth 12 or 1500*l.* per annum, which he held till his death. Upon this promotion he appointed Mr. Whiston his deputy in the mathematical professorship at Cambridge, giving him the full profits of the place, which appointment itself he also procured for him in 1703. The same year our author was chosen President of the Royal Society, in which chair he sat for 25 years, namely, till the time of his death; and he had been chosen a member of the Royal Academy of Sciences at Paris, in 1699, as soon as the new regulation was made for admitting foreigners into that society.

Ever since the first discovery of the heterogeneous mixture of light, and the production of colours thence arising, he had employed a good part of his time in bringing the experiment, upon which the theory is founded, to a degree of exactness that might satisfy himself. The truth is, this seems to have been his favourite invention; thirty years he had spent in this arduous task, before he published it in 1704. In infinite series and fluxions, and in the power and rule of gravity in preserving the solar system, there had been some, though distant, hints given by others before him; whereas in dissecting a ray of light into its primary constituent particles, which then admitted of no further separation; in the discovery of the different refrangibilities of these particles thus separated: and that these constituent rays had each its own peculiar colour inherent in it; that rays falling in the same angle of incidence have alternate fits of reflection and refraction; that bodies are rendered transparent by the minuteness of their pores, and become opaque by having them large; and that the most transparent body, by having a great thinness, will become less pervious to the light; in all these, which make up his new theory of light and colours, he was absolutely and entirely the first starter; and as the subject is of the most subtile and delicate nature, he thought it necessary to be himself the last finisher of it.

In fact, the affair that chiefly employed his researches for so many years was far from being confined to the subject of light alone. On the contrary, all that we know of natural bodies seemed to be comprehended in it; he had found out that there was a natural action, at a distance, between light and other bodies, by which both the reflections and refractions, as well as inflections, of the former were constantly produced. To ascertain the force and extent of this principle of action was what had all along engaged his thoughts, and what, after all, by its extreme subtlety, escaped his most penetrating spirit. However, though he has not made so full a discovery of this principle, which directs the course of light, as he has in regard to the power by which the planets are kept in their courses, yet he gave the best directions possible for such as should be disposed to carry on the work, and furnished matter abundantly sufficient to animate them to the pursuit. He has, indeed, hereby opened a way of passing from optics to an entire system of physics; and, if we look upon his queries as containing the history of a great man's first thoughts, even in that view they must be always at least entertaining and curious.

The same year, and in the same book with his Optics, he published, for the first time, his Method of Fluxions. It has been already observed, that these two inventions were intended for the public so long before as 1672; but were laid by then, in order to prevent his being engaged on that account in a dispute about them. And it is not a little remarkable that, even now, this last piece proved the occasion of another dispute, which continued for many years. Ever since 1684, Leibnitz had been artfully working the world into an opinion, that he first invented this method. Newton saw his design from the beginning, and had sufficiently obviated it in the first edition of the "Principia," in 1687, (*viz.* in the Scholium to the 2d lemma of the 2d book): and with the same view, when he now published that method, he took occasion to acquaint the world that he invented it in the years 1665 and 1666. In the "Acta Eruditorum" of Leipsic, where an account is given of this book, the author of that account ascribed the invention to Leibnitz, intimating that Newton borrowed it from him. Dr. Keill, astronomical professor at Oxford, undertook Newton's defence; and after several answers on both sides, Leibnitz complaining to the Royal Society, this body appointed a committee of their members to examine the merits of the case. These, after considering all the papers and letters relating to the point in controversy, decided in favour of Newton and Keill; as is related at large in the life of the last mentioned gentleman; and these papers themselves were published in 1712, under the title of "Commercium Epistolicum Johannis Collins," 8vo.

In 1705, the honour of knighthood was conferred upon our author by Queen Anne, in consideration of his great merit. And in 1714, he was applied to by the

House of Commons for his opinion upon a new method of discovering the longitude at sea by signals, which had been laid before them by Ditton and Whiston, in order to procure their encouragement; but the petition was thrown aside upon reading Newton's paper delivered to the committee.

The following year, 1715, Leibnitz, with the view of bringing the world more easily into the belief that Newton had taken the method of Fluxions from his Differential Method, attempted to foil his mathematical skill by the famous problem of the trajectories, which he, therefore, proposed to the English by way of challenge; but the solution of this, though the most difficult proposition he was able to devise, and what might pass for an arduous affair to any other, yet was hardly any more than an amusement to Newton's penetrating genius: he received the problem at 4 o'clock in the afternoon, as he was returning from the Mint; and, though extremely fatigued with business, yet he finished the solution before he went to bed.

As Leibnitz was Privy-Counsellor of Justice to the Elector of Hanover, so when that prince was raised to the British throne, Newton came more under the notice of the court: and it was for the immediate satisfaction of George the First, that he was prevailed on to put the last hand to the dispute about the invention of fluxions. In this Court, Caroline, Princess of Wales, afterwards Queen consort to George the Second, happened to have a curiosity for philosophical inquiries; no sooner, therefore, was she informed of our author's attachment to the House of Hanover, than she engaged his conversation, which soon endeared him to her. Here she found, in every difficulty, that full satisfaction which she had in vain sought for elsewhere; and she was often heard to declare, publicly, that she thought herself happy in coming into the world at a juncture of time which put it in her power to converse with him. It was at this Princess's solicitations that he drew up an abstract of his Chronology; a copy of which was at her request communicated, about 1718, to Signior Conti, a Venetian nobleman, then in England, upon a promise to keep it secret. But, notwithstanding this promise, the abbé, who while here had also affected to shew a particular friendship for Newton, though privately betraying him, as much as lay in his power, to Leibnitz, was no sooner got across the water, into France, than he dispersed copies of it, and procured an antiquary to translate it into French, as well as to write a confutation of it. This being printed at Paris in 1725, was delivered as a present from the bookseller that printed it, to our author, that he might obtain, as was said, his consent to the publication; but though he expressly refused such consent, yet the whole was published the same year. Hereupon Newton found it necessary to publish a defence of himself, which was inserted in the Philos. Trans. Thus, he who had so much all his life long been studious to avoid disputes, was unavoidably all his lifetime, in a manner, involved in them; nor did this last dispute even finish at his death, which happened the year following. Newton's paper was republished in 1726, at Paris, in French, with a letter of the Abbé Conti, in answer to it; and the same year some dissertations were printed there by Father Souciet, against Newton's Chronological Index; an answer to which was inserted, by Halley, in the Philos. Trans, No. 397.

Some time before this business, in his 80th year, our author was seized with an incontinence of urine, thought to proceed from the stone in the bladder, and deemed to be incurable. However, by the help of a strict regimen, and other precautions, which till then he never had occasion for, he procured considerable intervals of ease during the five remaining years of his life. Yet he was not free from some severe paroxysms, which even forced out large drops of sweat that ran down his face. In these circumstances he was never observed to utter the least complaint, nor express the smallest impatience; and as soon as he had a moment's ease he would smile, and talk with his usual cheerfulness. He was now obliged to rely upon Mr. Conduit, who had married his niece, for the discharge of his office in the Mint. Saturday morning, March 18, 1727, he read the newspapers, and discoursed a long time with Dr. Mead, his physician, having then the perfect use of all his senses and his understanding; but that night he entirely lost them all, and not recovering them afterwards, died the Monday following, March 20, in the 85th year of his age. His corpse lay in state in the Jerusalem Chamber, and on the 28th was conveyed into Westminster-Abbey, the pall being supported by the Lord Chancellor, the Dukes of Montrose and Roxburgh, and the Earls of Pembroke, Sussex, and Macclesfield. He was interred near the entrance into the choir, on the left hand, where a stately monument is erected to his memory, with a most elegant inscription upon it.

Newton's character has been attempted by Mr. Fontenelle and Dr. Pemberton, the substance of which is as follows. He was of a middle stature, and somewhat inclined to be fat in the latter part of his life. His countenance was pleasing and venerable at the same time, especially when he took off his peruke, and shewed his white hair, which was pretty thick. He never made use of spectacles, and lost but one tooth during his whole life. Bishop Atterbury says, that in the whole air of Sir Isaac's face and make there was nothing of that penetrating sagacity which appears in his compositions; that he had something rather languid in his look and manner, which did not raise any great expectation in those who did not know him.

His temper, it is said, was so equal and mild, that no accident could disturb it; a remarkable instance of which is related as follows: Sir Isaac had a favourite little dog, which he called Diamond. Being one day called out of his study into the next room, Diamond was left behind. When Sir Isaac returned, having been absent but a few minutes, he had the mortification to find that, Diamond having overset a lighted candle among some papers, the nearly finished labour of many years was in flames, and almost consumed to ashes. This loss, as Sir Isaac was then very far advanced in years, was irretrievable; yet, without once striking the dog, he only rebuked him with this exclamation: "O! Diamond! Diamond! thou little knowest the mischief thou hast done!"

He was indeed of so meek and gentle a disposition, and so great a lover of peace, that he would rather have chosen to remain in obscurity, than to have the calm of life ruffled by those storms and disputes which genius and learning always draw upon those that are most eminent for them.

From his love of peace, no doubt, arose that unusual kind of horror which he felt for all disputes; a steady unbroken attention, free from those frequent recoilings inseparably incident to others, was his peculiar felicity; he knew it, and he knew the value of it. No wonder then that controversy was looked on as his bane. When some objections, hastily made to his discoveries concerning light and colours, induced him to lay aside the design he had taken of publishing his optical lectures, we find him reflecting on that dispute, into which he had been unavoidably drawn, in these terms: "I blamed my own imprudence, for parting with so real a blessing as my quiet to run after a shadow." It is true this shadow, as Fontenelle observes, did not escape him afterwards, nor did it cost him that quiet which he so much valued, but proved as much a real happiness to him as his quiet itself; yet this was a happiness of his own making: he took a resolution from these disputes, not to publish any more concerning that theory, till he had put it above the reach of controversy, by the exactest experiments, and the strictest demonstrations; and accordingly it has never been called in question since. In the same temper, after he had sent the manuscript to the Royal Society, with his consent to the printing of it by them, yet upon Hook's injuriously insisting that he himself had demonstrated Kepler's problem before our author, he determined, rather than be again involved in a controversy, to suppress the third book; and he was very hardly prevailed upon to alter that resolution. It is true the public was thereby a gainer; that book, which is indeed no more than a corollary of some propositions in the first, being originally drawn up in the popular way, with a design to publish it in that form; whereas he was now convinced that it would be best not to let it go abroad without a strict demonstration.

In contemplating his genius, it presently becomes a doubt which of these endowments had the greatest share, sagacity, penetration, strength, or diligence; and after all, the mark that seems most to distinguish it is, that he himself made the justest estimation of it, declaring, that if he had done the world any service, it was due to nothing but industry and patient thought; that he kept the subject of consideration constantly before him, and waited till the first dawning opened gradually, by little and little, into a full and clear light. It is said that, when he had any mathematical problems or solutions in his mind, he would never quit the subject on any account. And his servant has said, when he has been getting up in a morning, he has sometimes begun to dress, and with one leg in his breeches, sat down again on the bed, where he has remained for hours before he has got his clothes on: and that dinner has been often three hours ready for him before he could be brought to table. Upon this head several little anecdotes are related; among which is the following. Dr. Stukely coming in accidentally one day, when Newton's dinner was left for him upon the table, covered up, as usual, to keep it warm till he could find it convenient to come to table; the doctor, lifting the cover, found under it a chicken, which he presently ate, putting the bones in the dish, and replacing the cover. Some time after Newton came into the room, and, after the usual compliments, sat down to his dinner; but on taking up the cover, and seeing only the bones of the fowl left, he observed, with some little surprise, "I thought I had not dined, but I now find that I have."

After all, notwithstanding his anxious care to avoid every occasion of breaking his intense application to study, he was at a great distance from being steeped in philosophy. On the contrary, he could lay aside his thoughts, though engaged in the most intricate researches, when his other affairs required his attention; and, as soon as he had leisure, resume the subject at the point where he had left off. This he seems to have done, not so much by any extraordinary strength of memory, as by the force of his inventive faculty, to which every thing opened itself again with ease, if nothing intervened to ruffle him. The readiness of his invention made him not think of putting his memory much to the trial; but this was the offspring of a vigorous intenseness of thought, out of which he was but a common man. He spent, therefore, the prime of his age in those abstruse researches, when his situation in a college gave him leisure, and while study was his proper business. But as soon as he was removed to the Mint, he applied himself chiefly to the duties of that office; and so far quitted mathematics and philosophy, as not to engage in any pursuits of either kind afterwards.

Dr. Pemberton observes, that though his memory was much decayed, in the last years of his life, yet he perfectly understood his own writings, contrary to what I had formerly heard, says the doctor, in discourse from many persons. This opinion of theirs might arise, perhaps, from his not being always ready at speaking on these subjects, when it might be expected he should. But on this head it may be observed, that great geniuses are often liable to be absent, not only in relation to common life, but with regard to some of the parts of science that they are best informed of; inventors seem to treasure up in their minds what they have found out, after another manner than those do the same things who have not this inventive faculty. The former, when they have occasion to produce their knowledge, are in some measure obliged immediately to investigate part of what they want; and for this they are not equally fit at all times; from whence it has often happened, that such as retain things chiefly by means of a very strong memory, have appeared off-hand more expert than the discoverers themselves.

It was evidently owing to the same inventive faculty that Newton, as this writer found, had read fewer of the modern mathematicians than one could have expected; his own prodigious invention readily supplying him with what he might have occasion for in the pursuit of any subject he undertook. However, he often censured the handling of geometrical subjects of algebraic calculations; and his book of Algebra, he called by the name of Universal Arithmetic, in opposition to the injudicious title of Geometry, which Des Cartes had given to the treatise, in which he shews how the geometrician may assist his invention by such kind of computations. He frequently praised Slusius, Barrow, and Huygens, for not being influenced by the false taste which then began to prevail. He used to commend the laudable attempt of Hugo d'Omerique to restore the ancient analysis; and very much esteemed Apolonius's book De Sectione Rationis, for giving us a clearer notion of that analysis than we had before. Dr. Barrow may be esteemed as having shewn a compass of invention, equal, if not superior, to any of the moderns, our author only excepted; but Newton particularly recommended Huygens's style and manner: he thought him the most elegant of any mathematical writer of modern times, and the truest imitator of the ancients.

Of their taste and mode of demonstration, our author always professed himself a great admirer; and even censured himself for not following them yet more closely than he did; and spoke with regret of his mistake at the beginning of his mathematical studies, in applying himself to the works of Des Cartes, and other algebraic writers, before he had considered the Elements of Euclid with that attention which so excellent a writer deserves.

But if this was a fault, it is certain it was a fault to which we owe both his great inventions in speculative mathematics, and the doctrine of fluxions and infinite series. And perhaps this might be one reason why his particular reverence for the ancients is omitted by Fontenelle, who, however, certainly makes some amends by that just eulogium which he makes of our author's modesty, which amiable quality he represents as standing foremost in the character of this great man's mind and manners. It was in reality greater than can be easily imagined, or will be readily believed; yet it always continued so, without any alteration, though the whole world, says Fontenelle, conspired against it; let us add, though he was thereby robbed of his invention of Fluxions. Nicholas Mercator, publishing his Logarithmotechnia in 1668, where he gave the quadrature of the hyperbola by an infinite series, which was the first appearance in the learned world of a series of this sort, drawn from the particular nature of the curve, and that in a manner very new and abstracted. Dr. Barrow, at that time at Cambridge, where Mr. Newton, then about twenty-six years of age, resided, recollected that he had met with the same thing, in the writings of that young gentleman, and there not confined to the hyperbola only, but extending, by general forms, to all sorts of curves, even such as are mechanical; to their quadratures, their rectifications, and centres of gravity; to the solids formed by their rotations, and to the superficies of those solids, so that, when their determinations were possible, the series stopped at a certain point, or at least their sums were given by stated rules; and if the absolute determinations were impossible, they could yet be infinitely approximated; which is the happiest and most refined method, says Fontenelle, of supplying the defects of human knowledge, that man's imagination could possibly invent. To be master of so fruitful and general a theory was a mine of gold to a geometrician; but it was a greater glory to have been the discoverer of so surprising and ingenious a system. So that Newton, finding by Mercator's book that he was in the way to it, and that others might follow in his track, should naturally have been forward to open his treasures, and secure the property which consisted in making the discovery; but he contented himself with his treasure which he had found, without regarding the glory. What an idea does it give us of his unparalleled modesty, when we find him declaring, that he thought Mercator had entirely discovered his secret, or that others would, before he should become of a proper age for writing! His manuscript upon Infinite Series was communicated to none but Mr. John Collins, and Lord Brounker, then president of the Royal Society, who had also done something in this way himself; and even that had not been complied with, but for Dr. Barrow, who would not suffer him to indulge his modesty so much as he desired.

It is further observed, concerning this part of his character, that he never talked either of himself or others, nor ever behaved in such a manner, as to give the most malicious censurers the least occasion even to suspect him of vanity. He was candid and affable, and always put himself upon a level with his company. He never thought either his merit or his reputation sufficient to excuse him from any of the common offices of social life. No singularities, either natural or affected, distinguished him from other men. Though he was firmly attached to the Church of England, he was averse from the persecution of the non-conformists. He judged of men by their manners, and the true schismatics, in his opinion, were the vicious and the wicked. Not that he confined his principles to natural religion, for it is said he was thoroughly persuaded of the truth of revelation; and amidst the great variety of books which he had constantly before him, that which he studied with the greatest application was the Bible, at least in the latter years of his life; and he understood the nature and force of moral certainty, as well as he did that of a strict demonstration.

Sir Isaac did not neglect the opportunities of doing good, when the revenues of his patrimony and a profitable employment, improved by a prudent economy, put it in his power. We have two remarkable instances of his bounty and generosity; one to Mr. Maclaurin, extra professor of mathematics at Edinburgh, to encourage whose appointment he offered 20*l.* a year to that office; and the other to his niece Barton, upon whom he settled an annuity of 100*l.* per annum. When decency upon any occasion required expense and shew, he was magnificent without grudging it, and with a very good grace; at all other times, that pomp, which seems great to low minds only, was utterly retrenched, and the expense reserved for better uses.

Newton never married; and it has been said that "perhaps he never had leisure to think of it; that, being immersed in profound studies during the prime of his age, and afterwards engaged in an employment of great importance, and even quite taken up with the company which his merit drew to him, he was not sensible of any vacancy in life, nor the want of a companion at home." These, however, do not appear to be any sufficient reasons for his never marrying, if he had had an inclination so to do. It is much more likely that he had a constitutional indifference to the state, and even to the sex in general.

He left at his death, it seems, 32,000*l.*, but he made no will; which, Fontenelle tells us, was because he thought a legacy was no gift. As to his works, besides what were published in his lifetime, there were found after his death, among his papers, several discourses upon the subjects of antiquity, history, divinity, chemistry, and mathematics; several of which were published at different times, as appears from the following catalogue of all his works: where they are ranked in the order of time in which those upon the same subject were published.

1. Several Papers relating to his Telescope, and his theory of Light and Colours, printed in the Philosophical Transactions, Numbers, 80, 81, 82, 83, 84, 85, 88, 96, 97, 110, 121, 123, 128; or Vols. 6, 7, 8, 9, 10, 11.

2. Optics, or a Treatise on the Reflections, Refractions, and Inflections, and the Colours of Light, 1704, 4to. A Latin Translation, by Dr. Clarke, 1706, 4to.; and a French Translation, by P. Caste, Amst. 1729, 2 vols. 12mo. Besides several English editions in 8vo.

3. Optical Lectures, 1728, 8vo.; also in several Letters to Mr. Oldenburg, Secretary to the Royal Society, inserted in the General Dictionary, under our author's article.

4. Lectiones Opticæ, 1729, 4to.

5. Naturalis Philosophiæ Principia Mathematica, 1687, 4to. A second edition in 1713, with a Preface by Roger Cotes. The third edition in 1726, under the direction of Dr. Pemberton. An English Translation by Motte, 1729, 2 vols, 8vo. printed in several editions of his works, in different nations, particularly an edition, with a large Commentary, by the two learned Jesuits, Le Seur and Jacquier, in 4 vols. 4to. in 1739, 1740, and 1742.

6. A System of the World, Translated from the Latin original, 1727, 8vo. This, as has been already observed, was at first intended to make the third book of his Principia. An English Translation by Motte, 1629, 8vo.

7. Several Letters to Mr. Flamstead, Dr. Halley, and Mr. Oldenburg.

8. A Paper concerning the Longitude, drawn up by order of the House of Commons.

9. Abregé de Chronologie, &c. 1726, under the direction of the Abbé Conti, together with some Observations upon it.

10. Remarks upon the Observations made upon a Chronological Index of Sir I. Newton, &c. Philosophical Transactions, vol. 33. See also the same, vols. 34 and 35, by Dr. Halley.

11. The Chronology of Ancient Kingdoms amended, &c. 1728, 4to.

12. Arithmetica Universalis, &c. under the inspection of Mr. Whiston, Cantab. 1707, 8vo. Printed without the author's consent, and even against his will, an offence which, it seems, was never forgiven. There are also English editions of the same, particularly one by Wilder, with a Commentary, in 1769, 2 vols. 8vo.; and a Latin edition, with a Commentary, by Castilion, 2 vols. 4to. Amst. &c.

13. Analysis per Quantitatum Series, Fluxiones, et Differentias, cum Enumeratione Linearum Tertii Ordinis, 1711, 4to. under the inspection of W. Jones, Esq. F. R. S. The last tract had been published before, together with another on the Quadrature of Curves, by the method of Fluxions, under the title of Tractatus duo de Speciebus et Magnitudine Figurarum Curvilinearum, subjoined to the first edition of his Optics, in 1704, and other Letters in the Appendix to Dr. Gregory's Catoptrics, &c. 1735, 8vo. Under this head may be ranked Newtoni Genesis Curvarum per Umbras, Leyden, 1740.

14. Several Letters relating to his dispute with Leibnitz, upon his right to the Invention of Fluxions; printed in the Commercium Epistolicum D. Johannis Collins et Aliorum, de Analysi Promota, jussu Societatis Regiæ editum, 1712, 8vo.

15. Postscript and Letter of M. Leibnitz to the Abbé Conti, with remarks, and a Letter of his own to that Abbé, 1717, 8vo. To which was added, Raphson's History of Fluxions, as a Supplement.

16. The method of Fluxions and Analysis, by Infinite Series, translated into English from the original Latin; to which is added, a Perpetual Commentary by the Translator, Mr. John Colson, 1736, 4to.

17. Several Miscellaneous Pieces and Letters, as follows: 1. A Letter to Mr. Boyle upon the Subject of the Philosopher's Stone; inserted in the General Dictionary under the article Boyle. 2. A Letter to Mr. Aston, containing Directions for his Travels; ibid. under our

Author's article. 3. An English Translation of a Latin Dissertation upon the Sacred Cubit of the Jews; inserted among the Miscellaneous Works of Mr. John Greaves, vol. 2, published by Dr. Thomas Birch, in 1737, 2 vols. 8vo. This dissertation was found subjoined to a work of Sir Isaac's, not finished, entitled Lexicon Propheticum. 4. Four Letters from Sir Isaac Newton to Dr. Bentley, containing some Arguments in proof of a Deity, 1756, 8vo. 5. Two letters to Mr. Clarke, &c.

18. Observations on the Prophecies of Daniel, and the Apocalypse of St. John, 1733, 4to.

19. Is. Newtoni Elementa Perspectivæ Universalis, 1746, 8vo.

20. Tables for Purchasing College Leases, 1742, 12mo.

21. Corollaries, by Whiston.

22. A Collection of Several Pieces of our Author's under the following title: Newtoni Is. Opuscula Mathematica Philos. et Philol. Collegit I. Castilioneus, Laus. 1744, 4to. 8 tomes.

23. Two Treatises of the Quadrature of Curves, and Analysis by Equations of an Infinite Number of Terms explained, translated by John Stewart, with a large Commentary, 1745, 4to.

24. Description of an Instrument for Observing the Moon's Distance from the Fixed Stars at Sea. Philosophical Transactions, vol. 42.

25. Newton also published Barrow's Optical Lectures, in 1699, 4to.; and Bern. Varenii Geographia, &c. 1681, 8vo.

26. The Whole Works of Newton, published by Dr. Horsley, 1779, 4to. in five volumes.

NEWTONIAN *philosophy*, the doctrine of the Universe, and particularly of the Heavenly bodies; their laws, affections, &c. as delivered by Sir Isaac Newton. The term Newtonian philosophy is applied very differently by different authors. Some under this philosophy include all the Corpuscular philosophy, considered as it now stands corrected and reformed, by the discoveries and improvements made in the several parts thereof by Sir Isaac Newton. In this sense it is that 'sGravesande calls his Elements of Physics, an Introduction to the Newtonian Philosophy; and in this sense, the Newtonian is the same with the new philosophy, in opposition to the Cartesian, the Peripatetic, and the ancient Corpuscular philosophy. Others, by Newtonian philosophy, mean the method or order which Sir Isaac observes in philosophizing, *viz.* the reasoning and drawing of conclusions directly from phenomena, exclusive of all previous hypotheses; the beginning from simple principles, deducing the first powers and laws of nature from a few select phenomena, and then applying those laws, &c. to account for other things; and in this sense the Newtonian is the same with Experimental philosophy. Others again, by Newtonian philosophy, mean that wherein physical bodies are considered mathematically, and where geometry and mechanics are applied to the solution of phenomena; in which sense the Newtonian is the same with the mechanical and mathematical philosophy. Others again, by Newtonian philosophy, understand that part of physical knowledge which Sir Isaac Newton has handled, improved, and demonstrated, in his Principia. And lastly, some, by Newtonian philosophy, mean the new principles which Sir Isaac has brought into philosophy, the new system founded thereon, and the new solutions of phenomena thence deduced; or that which characterizes and distinguishes his philosophy from all others: and this is the sense, in which we shall chiefly consider it.

As to the history of this philosophy, we have but little to say: it was first made public in 1686, by the author, then a fellow of Trinity College, Cambridge; and in the year 1713, republished with considerable improvements. Several other authors have since attempted to make it plainer, by setting aside many of the more sublime mathematical researches, and substituting either more obvious reasonings, or experiments in lieu thereof; particularly Mr. Whiston, in his Prelect. Phys. Mathem., 'sGravesande, in his Elm. and Inst. and the learned Comment of Le-Seur and Jacquier upon Sir Isaac's Principia.

The philosophy itself is laid down chiefly in the third book of the Principia; the two preceding books being taken up in preparing the way, and demonstrating such principles of mathematics as have the most relation to philosophy: such are the laws and conditions of powers: and these, to render them less dry and geometrical, the author illustrates by scholia in philosophy, relating chiefly to the density and resistance of bodies, the motion of light and sounds, a vacuum, &c. In the third book he proceeds to the philosophy itself; and from the same principles deduces the structure of the universe and the powers of gravity, whereby bodies tend towards the Sun and planets; and from these powers, the motions of the planets and comets, the theory of the Moon and the tides. This book, which he calls De Mundi Systemate, he tells us, was first written in the popular way; but considering that such as are unacquainted with the said principles would not conceive the force of the consequences, nor be induced to lay aside their ancient prejudices; for this reason, and to prevent the thing from being in continual dispute, he digested the sum of that book into propositions, in the mathematical manner, so as it might only come to be read by such as had first considered the principles; not that it is necessary a man should master them all; many of them, even the first rate mathematicians, would find a difficulty in getting over. It is enough to have read the definitions, laws of motion, and the three first sections of the first book; after which, the author himself directs us to pass on to the book De Systemate Mundi.

The great principle on which the whole philosophy is founded is the power of gravity: this principle is not new; Kepler, long ago, hinted at it in his Introduct. ad Mot. Martis. He even discovered some of the properties thereof, and their effects in the motions of the primary planets: but the glory of bringing it to a physical demonstration was reserved to the English philosopher. See GRAVITATION. His proof of this principle from phenomena, together with the application of the same principle to the various other appearances of nature, or the deducing those appearances from that principle, constitute the Newtonian system; which, drawn in miniature, will stand thus:

I. The phenomena are, 1. That the satellites of Jupiter do, by radii drawn to the centre of the planet, describe areas proportional to the times; and that their periodical times are in a sesquiplicate ratio of their distances from its centre; in which the observations of all astronomers agree. 2. The same phenomenon holds of the satellites of Saturn, with regard to Saturn; and of the Moon, with regard to the Earth. 3. The periodical times of the primary planets about the Sun are in a sesquiplicate ratio of their mean distances from the Sun. But, 4. The primary planets do not describe areas any way proportional to their periodical times about the Earth; as being sometimes seen stationary, and sometimes retrograde, with regard thereto.

II. The powers whereby the satellites of Jupiter are constantly drawn out of their rectilinear course, and retained in their orbits, respect the centre of Jupiter, and are reciprocally as the squares of their distances from the same centre. The same holds of the satellites of Saturn, with regard to Saturn; of the Moon with regard to the Earth; and of the primary planets, with regard to the Sun. See CENTRAL FORCES.

III. The moon gravitates towards the Earth, and by the power of that gravity is retained in her orbit: and the same holds of the other satellites, with respect to their primary planets; and of the primary planets, with respect to the Sun.

As to the Moon, the proposition is thus proved; the Moon's mean distance is 60 semidiameters of the Earth; her period, with regard to the fixed stars, is 27 days, 7 hours, 43 minutes; and the Earth's circumference 123,249,600 Paris feet. Now, supposing the Moon to have lost all her motion, and to be let drop to the Earth, with the power which retains her in her orbit, in the space of one minute she will fall $15\frac{1}{12}$ Paris feet; the arch she describes in her mean motion, at the distance of 60 diameters of the Earth, being the versed sign of $15\frac{1}{12}$ Paris feet. Hence, as the power, as it approaches the Earth, increases in a duplicate ratio of the distance inversely; so as at the surface of the Earth it is 60×60 greater than at the Moon; a body falling with that force in our region must, in a minute's time, describe the space of $60 \times 60 \times 15\frac{1}{12}$ Paris feet, or $15\frac{1}{12}$ Paris feet in the space of one second.

But this is the rate at which bodies fall by their gravity at the surface of our Earth, as Huygens has demonstrated by experiments with pendulums. Consequently, the power whereby the Moon is retained in her orbit is the very same we call gravity; for, if they were different, a body falling with both powers together would descend with double the velocity, and in a second of time describe $30\frac{1}{6}$ feet.

As to the other secondary planets, their phenomena, with respect to their primary ones, being of the same kind with those of the Moon about the Earth, it is argued, by analogy, that they depend on the same causes; it being a rule or axiom all philosophers agree to, that effects of the same kind have the same causes. Again, attraction is always mutual, *i. e.* the reaction is equal to the action: consequently the primary planets gravitate towards their secondary ones, the Earth towards the Moon, and the Sun towards them all. And this gravity, with regard to each several planet, is reciprocally as the square of its distance from the centre of gravity. See Attraction, &c.

IV. All bodies gravitate towards all the planets: and their weight towards any one planet, at equal distances from the centre of the planet, is proportional to the quantity of matter in each.

For the law of the descent of heavy bodies towards the Earth, setting aside their unequal retardation from the resistance of the air, is this, that all bodies fall equal spaces in equal times; but the nature of gravity or weight, no doubt, is the same on the other planets as on the Earth.

Suppose, *e. gr.* such bodies raised to the surface of the Moon, and, together with the Moon, deprived at once of all progressive motion, and dropped towards the Earth: it is shewn, that in equal times they will describe equal spaces with the Moon; and therefore, that their quantity of matter is to that of the Moon, as their weights to its weight.

Add, that since Jupiter's satellites revolve in times that are in a sesquiplicate ratio of their distances from the centre of Jupiter, and consequently at equal distances from Jupiter, their accelerating gravities are equal; therefore, falling equal altitudes in equal times, they will describe equal spaces; just as in heavy bodies on our Earth. And the same argument will hold of the primary planets with regard to the Sun, and the powers whereby unequal bodies are equally accelerated as the bodies, *i. e.* the weights are as the quantities of matter in the planets, and the weight of the primary and secondary planets towards the Sun are as the quantities of matter in the planets and satellites.

And hence are several corollaries drawn relating to the weights of bodies on the surface of the Earth, magnetism, and the existence of a vacuum.

V. Gravity extends itself towards all bodies, and is in proportion to the quantity of matter in each.

That all planets gravitate towards each other has been already shewn; likewise, that the gravity towards any one, considered apart, is reciprocally as the squares of its distance from the centre of the planet; consequently, gravity is proportionable to the matter therein. Further, as all the parts of any planet, A, gravitate towards another planet, B; and the gravity of any part is to the gravity of the whole, as the matter of the part to the matter of the whole; and as reaction is equal to action; the planet B will gravitate towards all the parts of the planet A; and its gravity towards any part will be to its gravity towards the whole, as the matter of the part to the matter of the whole. Hence we derive the methods of finding and comparing weights of bodies towards different planets; of finding the quantity of matter in the several planets, and their densities; since the weights of equal bodies, revolving about planets, are as the diameter of their orbits directly, and as the squares of the periodical times inversely; and the weights at any distance from the centre of the planet are greater or less in a duplicate ratio of their distances inversely. And since the quantities of matter in the planets are as their powers at equal distances from their centres; and, lastly, since the weights of equal and homogeneous bodies towards homogeneous spheres are, at the surface of the spheres, as the diameters of those spheres; and consequently, the densities of heterogeneous bodies are as the weights at the diameters of the spheres.

VI. The common centre of gravity of the Sun and all the planets is at rest; and the Sun, though always in motion, yet never recedes far from the common centre of all the planets.

For the matter in the Sun being to that in Jupiter as 1033 to 1; and Jupiter's distance from the Sun to the semi-diameter of the Sun in a ratio somewhat bigger; the common centre of gravity of Jupiter and the Sun will be a point a little without the Sun's surface; and by the same means the common centre of Saturn and the Sun will be a point a little within the Sun's surface; and the common centre of the Earth, and all the planets, will be scarce one diameter of the Sun distant from the centre thereof; but the centre is always at rest: therefore, though the Sun will have a motion this and that way, according to the various situations of the planets, yet it can never recede far from the centre; so that the common centre of gravity of the Earth, Sun, and Planets, may be esteemed the centre of the whole world. See PLANET.

VII The planets move in ellipses that have their foci in the centre of the Sun; and describe areas proportionable to their times. This we have already laid down *à posteriori* as a phenomenon: and now that the principle of the heavenly motions is shewn, we deduce it therefrom *à priori*. Thus, since the weights of the planets towards the Sun are reciprocally as the squares of their distances from the centre of the Sun; if the Sun were at rest, and the other planets did not act on each other, their orbits would be elliptical, having the Sun in the common umbilicus, and would describe areas proportionable to the times; but the mutual actions of the planets are very small, and may be well thrown aside.

Indeed, the action of Jupiter on Saturn is of some consequence; and hence, according to the different situations and distances of those two planets, their orbits will be a little disturbed. The Earth's orbit too is sensibly disturbed by the action of the Moon; and the common centre of the two describes an ellipsis round the Sun placed in the umbilicus; and, with a radius drawn to the centre of the Sun, describes areas proportionable to the times. See EARTH, &c.

VIII. The aphelia and nodes of the planets are at rest, excepting for some inconsiderable irregularities, arising from the action of the revolving planets and comets. Consequently, as the fixed stars retain their position to the aphelia and nodes, they too are at rest.

IX. The axis, or polar diameter, of the planets is less than the equatorial diameter. The planets, had they no diurnal rotation, would be spheres, as having an equal gravity on every side: but by this rotation the parts receding from the axis endeavour to rise towards the equator, which, if the matter they consist of be fluid, will be affected very sensibly. Accordingly, Jupiter, whose density is found not much to exceed that of water on our globe, is observed by astronomers to be considerably less between the two poles than from east to west. And, on the same principle, unless our Earth were higher at the equator than towards the poles, the sea would rise under the equator, and overflow all near it. But this figure of the Earth Sir Isaac Newton proves likewise *à posteriori*, from the oscillations of pendulums being slower and smaller in the equinoctial, than in the polar parts of the globe. See EARTH.

X. All the Moon's motions, and all the inequalities of these motions, follow from these principles, *e. gr.* her unequal velocity, and that of her nodes and apogee in the syzygies and quadratures; the differences in her eccentricity and her variation. See MOON.

XI. From the inequalities of the lunar motions, we can deduce the several inequalities in the motions of the satellites.

XII. From these principles, particularly the action of the Sun and Moon upon the Earth, it follows, that we must have tides, or that the sea must swell and subside twice every day. See TIDES.

XIII. Hence, likewise, follows the whole theory of comets, as that they are above the region of the Moon, and in the planetary spaces; that they shine by the Sun's light, reflected from them; that they move in conic sections, whose umbilici are in the centre of the Sun; and, by radii drawn to the Sun, describe areas proportional to the times; that the orbits, or trajectories, are very nearly parabolas; that their bodies are solid, compact, &c. like those of the planets, and must therefore acquire an immense heat in their perihelia; that their tails are exhalations arising from and encompassing them like atmospheres. See ASTRONOMY.

NEW *trial*, in law. Formerly the only remedy for a reversal of a verdict, unduly given, was by writ of attaint; but this course is now justly exploded, and a new trial is granted, upon application to the court from which the cause issued.

A new trial, in many cases, may be absolutely necessary. But it is not granted upon nice and formal objections, which do not go to the real merits; nor where the scales of evidence hang nearly equal. It is generally upon some misdirection by the judge to the jury, in point of law, or where a jury has found a verdict directly against evidence; but where there has been evidence as to the fact in doubt, on both sides, the court will not interfere. It is also granted, where damages have been given beyond the ordinary measure of justice; and where the party has been surprised by some evidence, which he has subsequently the means of answering, but had not at the trial. It is always refused, where the damages do not exceed 10*l*.

NICANDRIA, in botany, so named from Nicander of Colophon, a genus of the Decandria Monogynia class and order. Essential character: calyx turbinate, coloured; four parted: corolla one-petalled, ten-cleft; germ encircled with a membranaceous ring; stigma peltate, orbicular, six-rayed; berry roundish, six grooved, three celled, many-seeded. There is one species, *viz.* N. amara, a native of the large forest of Guiana.

END OF VOL. VIII.

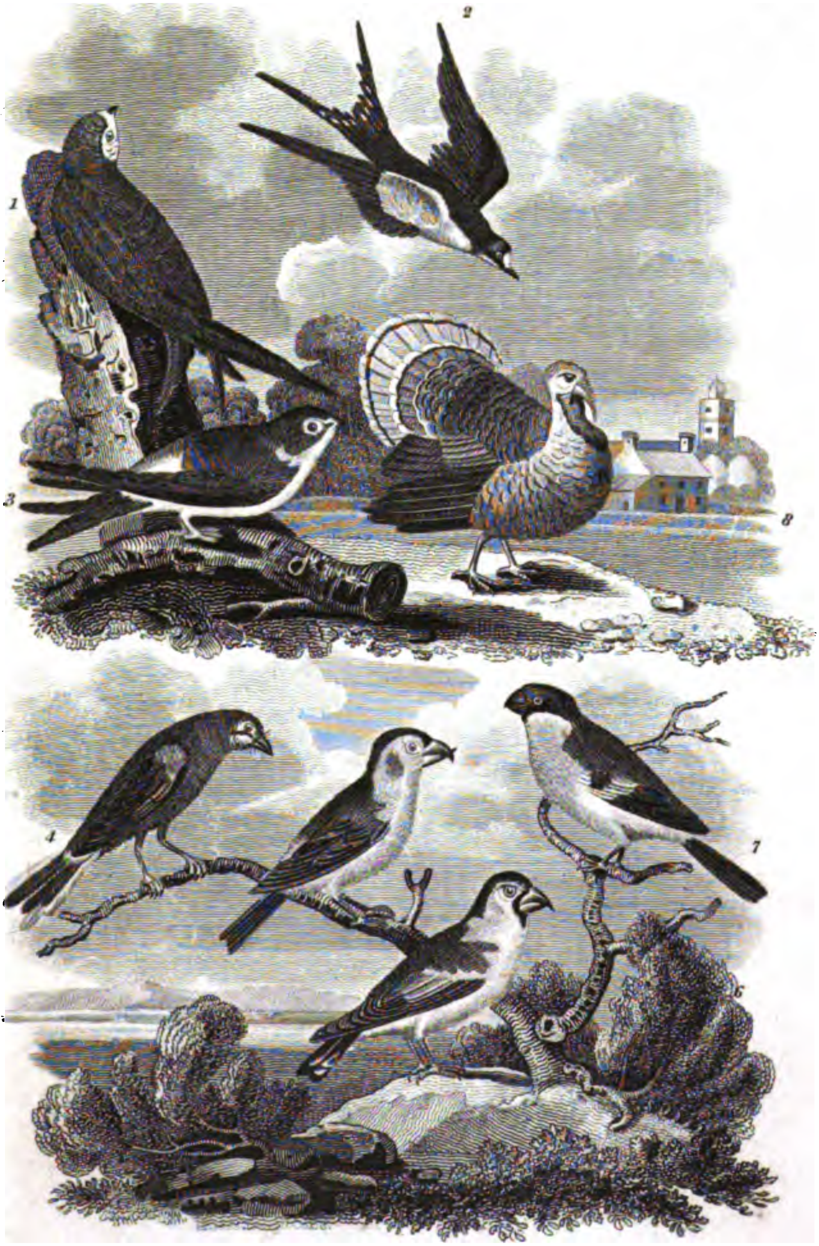


Fig. 1. Hirundo *Apus: Swift* _ *Fig. 2.* H. *Rustica: Swallow* _ *Fig. 3.* H. *Urbica: Martin* _ *Fig. 4.* Lanius *Curvirostris: Hook billed Shrike* _ *Fig. 5.* Loxia *Curvirostris: Crossbill* _ *Fig. 6.* L. *Coccothraustis: Hawfinch* _ *Fig. 7.* L. *Pyrrhula Bullfinch* _ *Fig. 8.* Meleagris *Gallipavo: Turkey.*

AVES.

Plate IX.

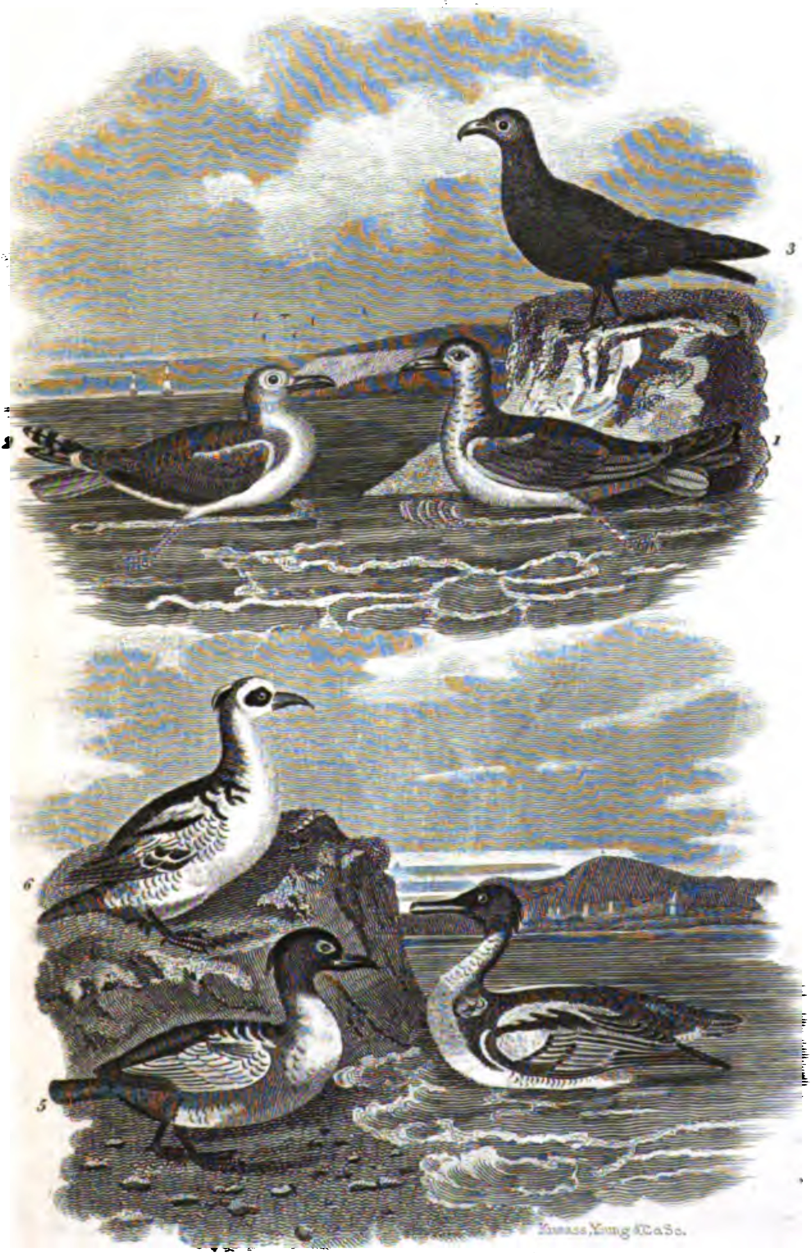


Fig.1. Larus *canus: Common Gull* – *Fig.2.* L. *marinus: Black backed Gull* – *Fig.3.* L. *crepidatus Black toed Gull* *Fig.4.* Mergus *serrator: Red breasted Merganser* – *Fig.5.* M. *merganser Goosander* – *Fig.6.* M. *albellus: Smew.*

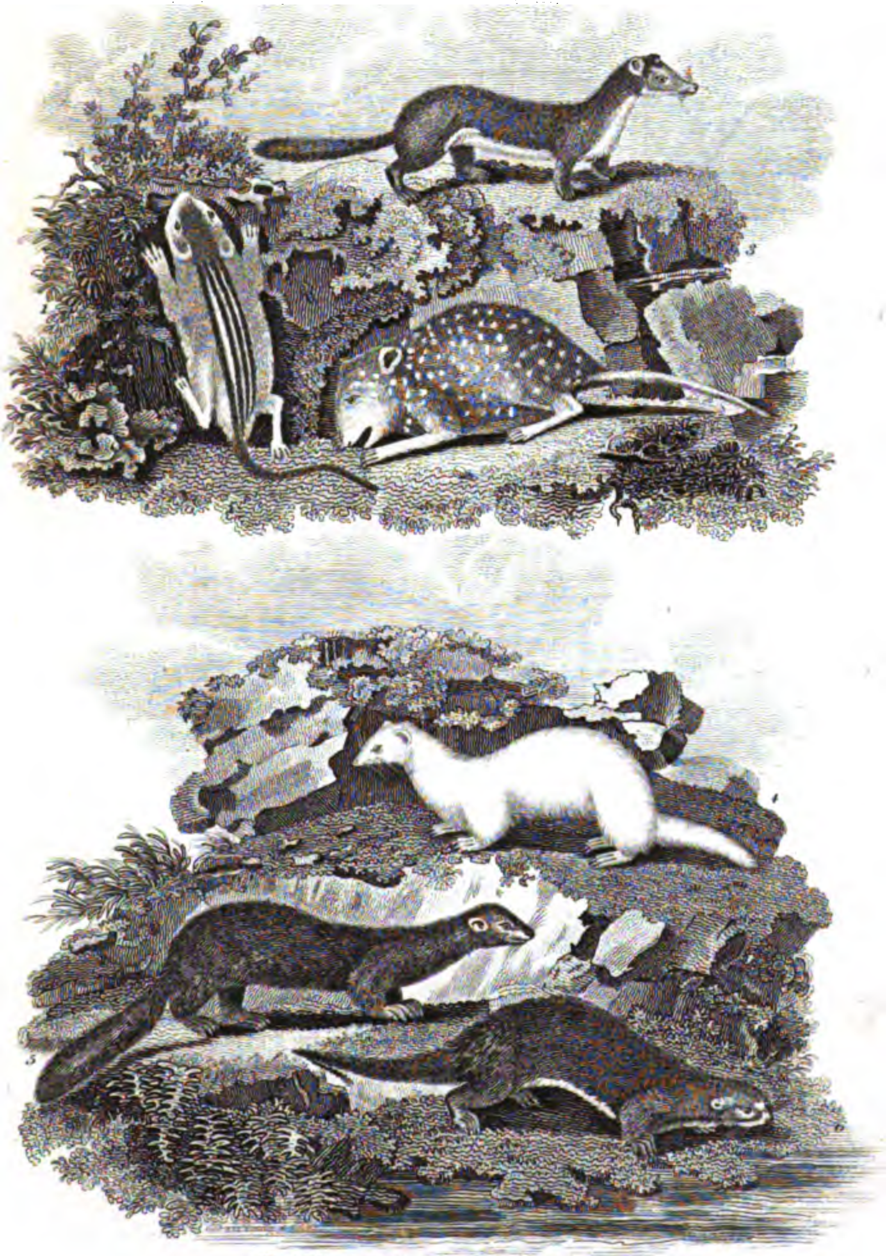


Fig. 1. Mus pumilio. Lineated Mouse.
— 2. —— striatus. Striated Mouse.
— 3. Mustella erminea. Stoat.
— 4. —— furo. Ferret.
— 5. —— zibellina. Sable.
— 6. —— lutra. Otter.

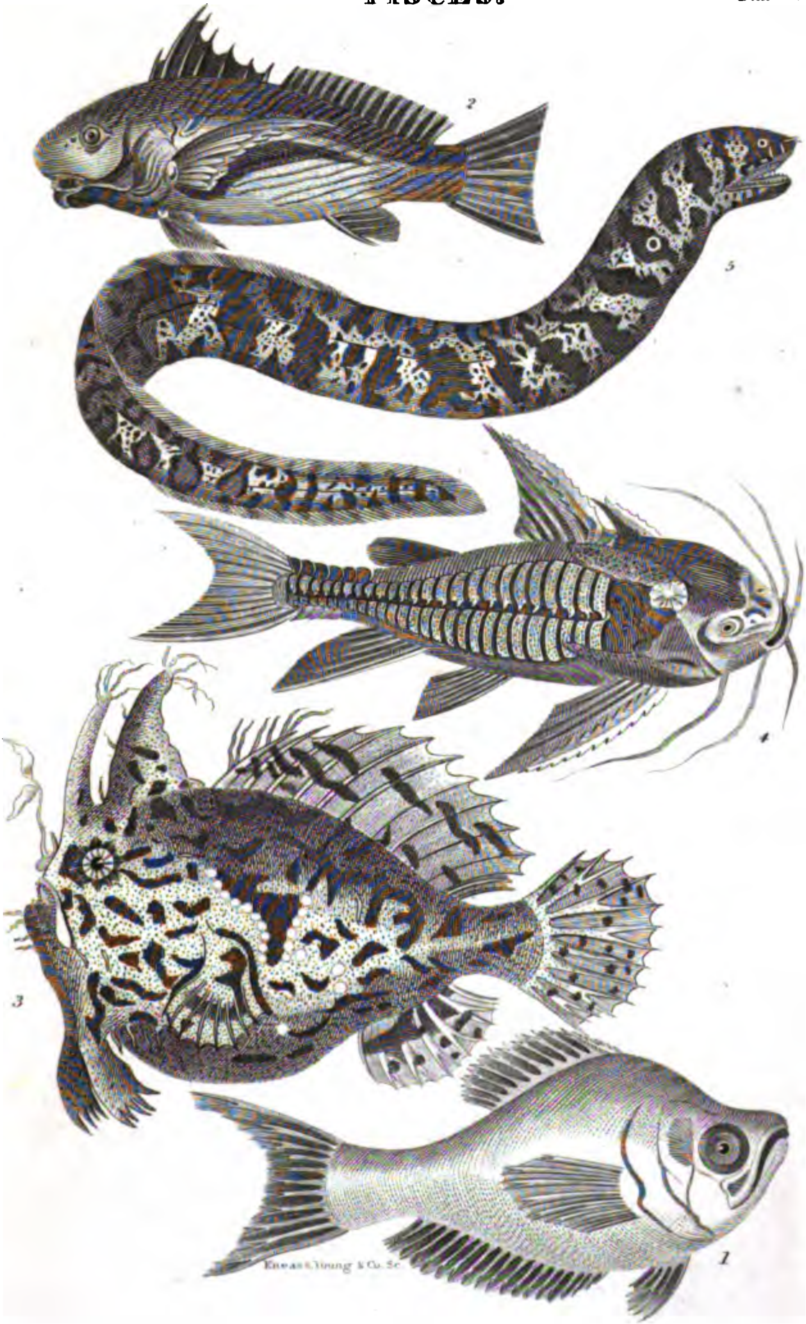
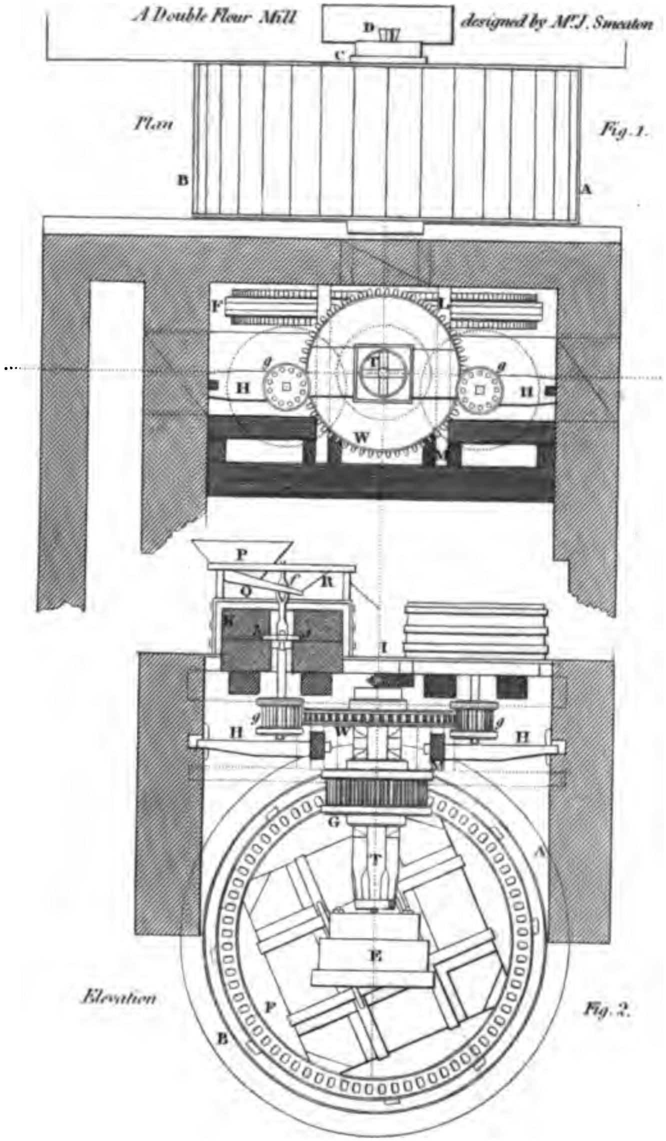


Fig. 1. **Kurtus** *Indicus: Indian Kurtus_ Fig. 2.* **Labrus** *formosus: Blue finned Labrus_ Fig. 3.* **Lophius** *piscatorius: Harlequin Angler_ Fig. 4.* **Loricaria** *costata: ribbed loricaria Fig. 5.* **Muræna** *catenata: chain striped Muræna.*

MILL WORK.

A Double Flour Mill designed by Mr. J. Smeaton



Scale of Feet

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Reduced from the Original drawing in the possession of Sir Joseph Banks K.B. by J. Farey Junr.

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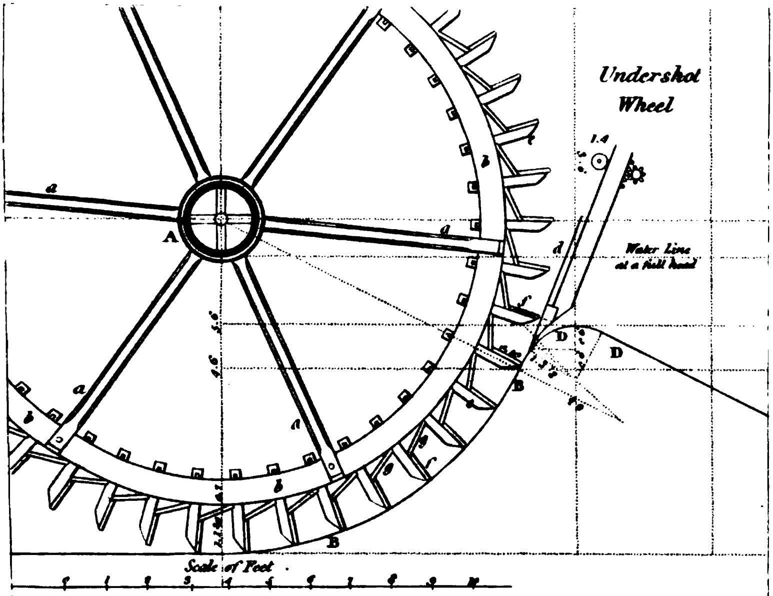
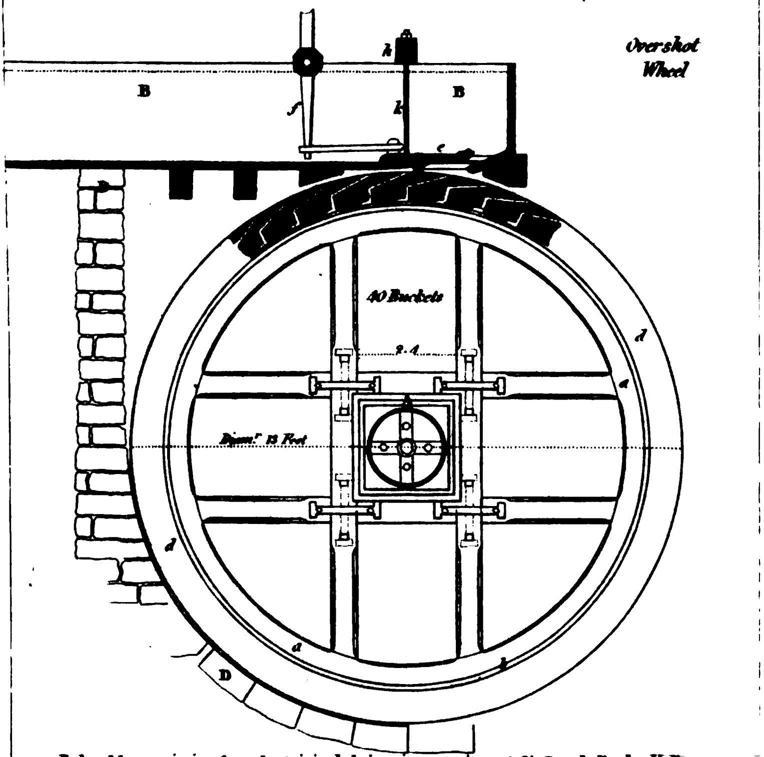
WATER WHEELS.

Designed by Mr. John Smeaton





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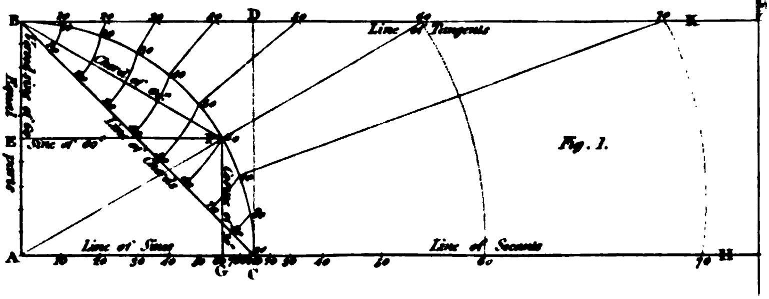
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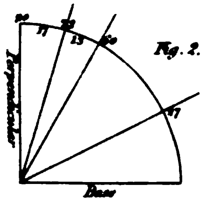
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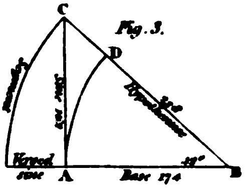
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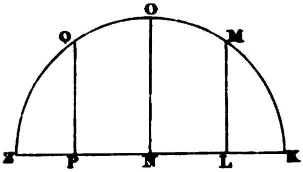
Fig. 4.



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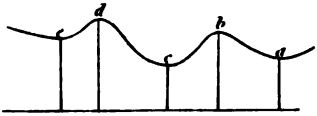

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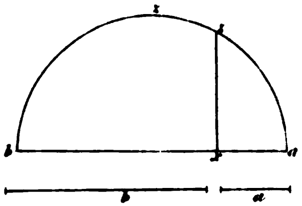

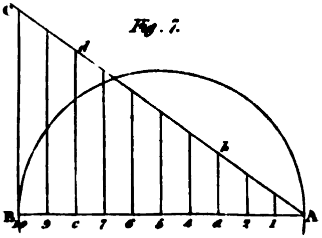
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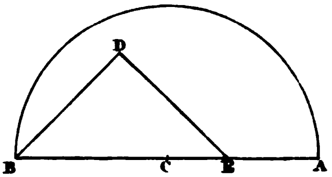

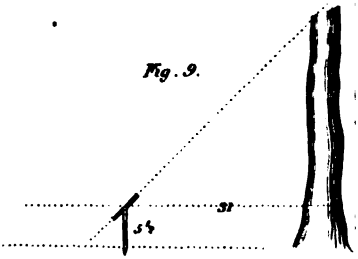
Fig. 9.

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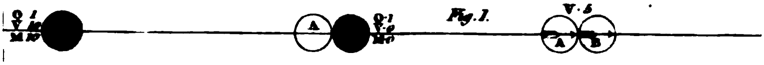

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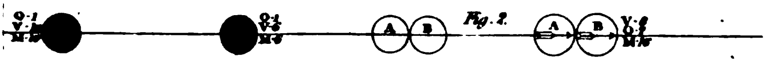

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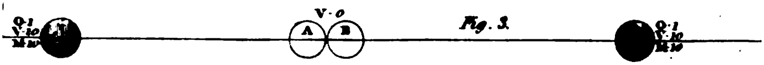

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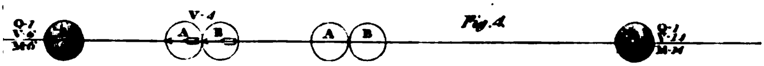

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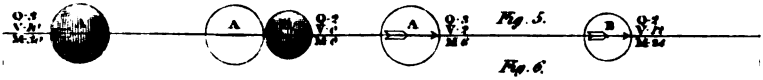

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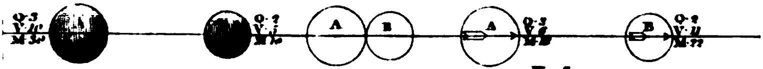

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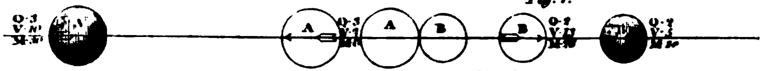

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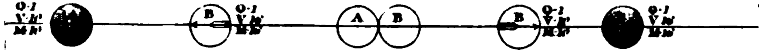

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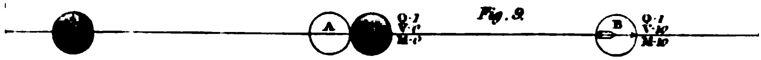

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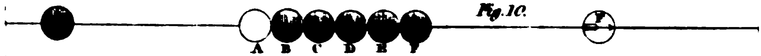

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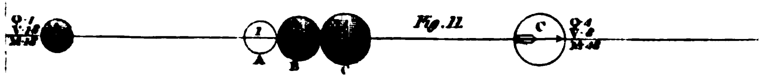

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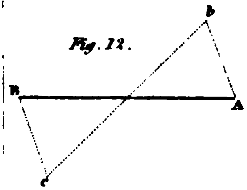

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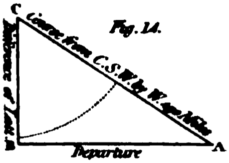

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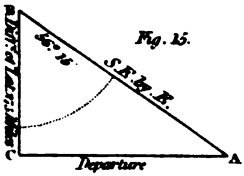

Fig 13

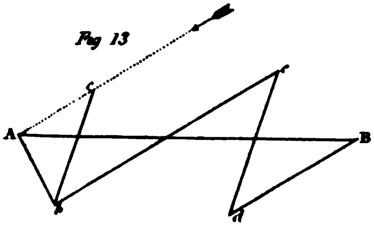

Fig. 16.